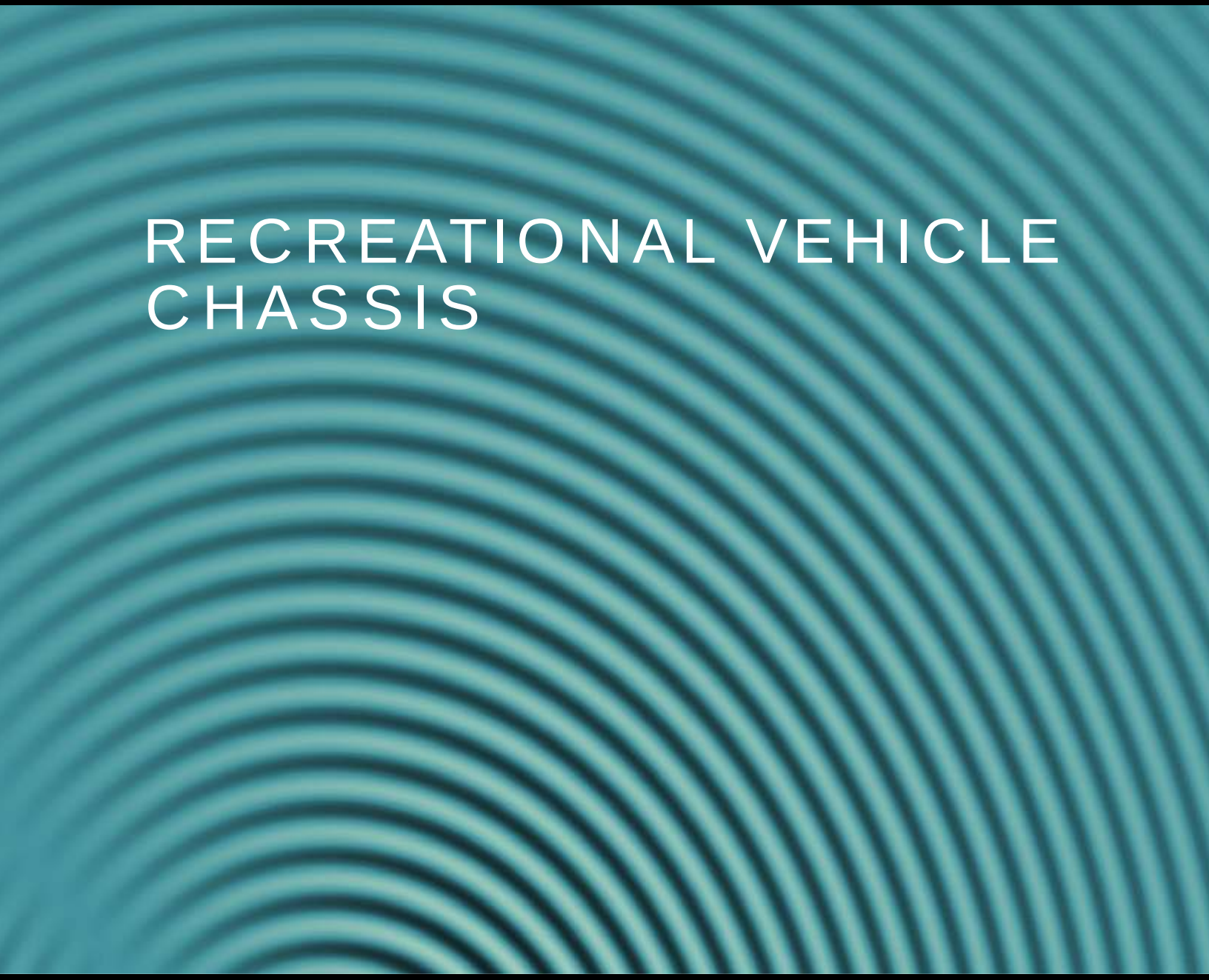

RECREATIONAL VEHICLE CHASSIS

Maintenance Manual

STI-425-6
A24-00788-000

RECREATIONAL VEHICLE CHASSIS MAINTENANCE MANUAL

Models: MC
MCL
XCL
XCM
XCP
XCR
XCS

STI-425-6 (6/15)

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Foreword

Scheduled maintenance provides a key element for safe operation of your vehicle. A proper maintenance program also helps to minimize downtime and to safeguard warranties. This maintenance manual provides information necessary for years of safe, reliable, and cost-efficient vehicle operation.

IMPORTANT: The maintenance operations in this manual are **not all-inclusive**. Also refer to other component and body manufacturers' instructions for specific inspection and maintenance instructions.

Perform the pretrip inspection and daily/weekly/monthly maintenance as outlined in the vehicle operator's manual. Perform the operations in this maintenance manual at scheduled intervals based upon distance traveled or months of operation. Your authorized servicing dealer has the qualified technicians and equipment to perform this maintenance for you. Your dealership can also set up a scheduled maintenance program tailored specifically to your needs. Optionally, your dealership can assist you in learning how to perform the maintenance procedures in this manual.

IMPORTANT: Descriptions and specifications in this manual were in effect at the time of printing. Freightliner Custom Chassis Corporation (FCCC) reserves the right to discontinue models and to change specifications or design at any time without notice and without incurring obligation. Descriptions and specifications contained in this publication provide no warranty, expressed or implied, and are subject to revision and editions without notice.

Refer to **www.Daimler-TrucksNorthAmerica.com** and **www.FreightlinerChassis.com** for more information, or contact Daimler Trucks North America LLC at the address below.

Environmental Concerns and Recommendations

Whenever you see instructions in this manual to discard materials, you should attempt to reclaim and recycle them. To preserve our environment, follow appropriate environmental rules and regulations when disposing of materials.

NOTICE: Parts Replacement Considerations

Do not replace suspension, axle, or steering parts (such as springs, wheels, hubs, and steering gears) with used parts. Used parts may have been subjected to collisions or improper use and have undetected structural damage.

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Daimler Trucks North America LLC
Service Systems and Documentation (CVI-SSD)
P.O. Box 3849
Portland, OR 97208-3849

Descriptions of Service Publications

Daimler Trucks North America LLC distributes the following major service publications in paper and electronic (via ServicePro®) formats.

Workshop/Service Manual

Workshop/service manuals contain service and repair information for all vehicle systems and components, except for major components such as engines, transmissions, and rear axles. Each workshop/service manual section is divided into subjects that can include general information, principles of operation, removal, disassembly, assembly, installation, and specifications.

Maintenance Manual

Maintenance manuals contain routine maintenance procedures and intervals for vehicle components and systems. They have information such as lubrication procedures and tables, fluid replacement procedures, fluid capacities, specifications, and procedures for adjustments and for checking the tightness of fasteners. Maintenance manuals do not contain detailed repair or service information.

Driver's/Operator's Manual

Driver's/operator's manuals contain information needed to enhance the driver's understanding of how to operate and care for the vehicle and its components. Each manual contains a chapter that covers pre-trip and post-trip inspections, and daily, weekly, and monthly maintenance of vehicle components. Driver's/operator's manuals do not contain detailed repair or service information.

Service Bulletins

Service bulletins provide the latest service tips, field repairs, product improvements, and related information. Some service bulletins are updates to information in the workshop/service manual. These bulletins take precedence over workshop/service manual information, until the latter is updated; at that time, the bulletin is usually canceled. The service bulletins manual is available only to dealers. When doing service work on a vehicle system or part, check for a valid service bulletin for the latest information on the subject.

IMPORTANT: Before using a particular service bulletin, check the current service bulletin validity list to be sure the bulletin is valid.

Parts Technical Bulletins

Parts technical bulletins provide information on parts. These bulletins contain lists of parts and BOMs needed to do replacement and upgrade procedures.

Web-based repair, service, and parts documentation can be accessed using the following applications on the AccessFreightliner.com website.

ServicePro

ServicePro® provides Web-based access to the most up-to-date versions of the publications listed above. In addition, the Service Solutions feature provides diagnostic assistance with Symptoms Search, by connecting to a large knowledge base gathered from technicians and service personnel. Search results for both documents and service solutions can be narrowed by initially entering vehicle identification data.

PartsPro

PartsPro® is an electronic parts catalog system, showing the specified vehicle's build record.

EZWiring

EZWiring™ makes Freightliner Custom Chassis Corporation, Freightliner, Sterling, Thomas Built Buses, and Western Star products' wiring drawings and floating pin lists available online for viewing and printing. EZWiring can also be accessed from within PartsPro.

Descriptions of Service Publications

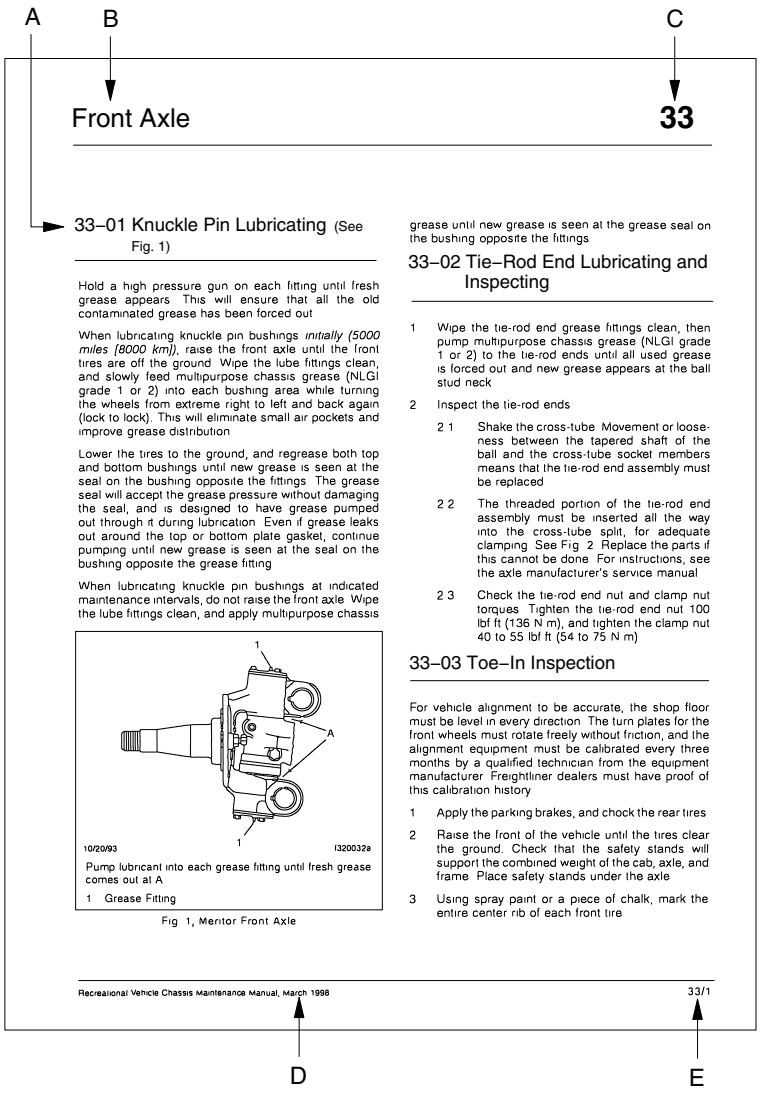
Warranty-related service information available on the AccessFreightliner.com website includes the following documentation.

Recall Campaigns Recall campaigns cover situations that involve service work or replacement of parts in connection with a recall notice. These campaigns pertain to matters of vehicle safety. All recall campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

Field Service Campaigns Field service campaigns are concerned with non-safety-related service work or replacement of parts. All field service campaigns are distributed to dealers; customers receive notices that apply to their vehicles.

Page Description

For an example of a maintenance manual page, see **Fig. 1**.


A
B
C
Front Axle
33
33–01 Knuckle Pin Lubricating (See Fig. 1)
Hold a high pressure gun on each fitting until fresh grease appears. This will ensure that all the old contaminated grease has been forced out
When lubricating knuckle pin bushings *initially (5000 miles [8000 km])*, raise the front axle until the front tires are off the ground. Wipe the lube fittings clean, and slowly feed multipurpose chassis grease (NLGI grade 1 or 2) into each bushing area while turning the wheels from extreme right to left and back again (lock to lock). This will eliminate small air pockets and improve grease distribution
Lower the tires to the ground, and regrease both top and bottom bushings until new grease is seen at the seal on the bushing opposite the fittings. The grease seal will accept the grease pressure without damaging the seal, and is designed to have grease pumped out through it during lubrication. Even if grease leaks out around the top or bottom plate gasket, continue pumping until new grease is seen at the seal on the bushing opposite the grease fitting
When lubricating knuckle pin bushings at indicated maintenance intervals, do not raise the front axle. Wipe the lube fittings clean, and apply multipurpose chassis grease until new grease is seen at the grease seal on the bushing opposite the fittings
1
A
1
10/20/93
I320032a
Pump lubricant into each grease fitting until fresh grease comes out at A
1 Grease Fitting
Fig. 1, Meritor Front Axle
33–02 Tie–Rod End Lubricating and Inspecting
1 Wipe the tie-rod end grease fittings clean, then pump multipurpose chassis grease (NLGI grade 1 or 2) to the tie-rod ends until all used grease is forced out and new grease appears at the ball stud neck
2 Inspect the tie-rod ends
2.1 Shake the cross-tube. Movement or looseness between the tapered shaft of the ball and the cross-tube socket members means that the tie-rod end assembly must be replaced
2.2 The threaded portion of the tie-rod end assembly must be inserted all the way into the cross-tube split, for adequate clamping. See Fig. 2. Replace the parts if this cannot be done. For instructions, see the axle manufacturer's service manual
2.3 Check the tie-rod end nut and clamp nut torques. Tighten the tie-rod end nut 100 lbf ft (136 N·m), and tighten the clamp nut 40 to 55 lbf ft (54 to 75 N·m)
33–03 Toe–In Inspection
For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history
1 Apply the parking brakes, and chock the rear tires
2 Raise the front of the vehicle until the tires clear the ground. Check that the safety stands will support the combined weight of the cab, axle, and frame. Place safety stands under the axle
3 Using spray paint or a piece of chalk, mark the entire center rib of each front tire
Recreational Vehicle Chassis Maintenance Manual, March 1998
33/1
D
E

11/11/2002 f020075

A. Maintenance Operation Number consists of the Group Number followed by the Sequence Number
B. Group Title
C. Group Number
D. Release Date
E. Group Number/Page Number

Fig. 1, Example of a Maintenance Manual Page

Maintenance Manual Contents

Group No.	Group Title
00	General Information
01	Engine
09	Air Intake
15	Alternators and Starters
20	Engine Cooling/Radiator
26	Transmission
30	Throttle Control
32	Suspension
33	Front Axle
35	Rear Axle
40	Wheels and Tires
41	Driveline
42	Brakes
46	Steering
47	Fuel
49	Exhaust
54	Electrical
83	Heater and Air Conditioner

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
15,000 Mile or 12 Month Maintenance	00–04
30,000 Mile or 24 Month Maintenance	00–05
45,000 Mile or 36 Month Maintenance	00–06
60,000 Mile or 48 Month Maintenance	00–07
6000 Mile or 6 Month Initial Maintenance	00–03
General Maintenance Schedule Information	00–01
Noise Emission Controls Maintenance	00–08
Vehicle Maintenance Schedule Table	00–02
Verification of Inspections Log	00–09

General Maintenance Schedule Information

General Maintenance Schedule Information

Performing regular maintenance on your vehicle will help ensure that your vehicle delivers safe reliable service and optimum performance for years to come. Failure to follow a regular maintenance program can result in inefficient operation and unscheduled down time.

When the vehicle reaches the distance or time (whichever comes first) given for a maintenance interval, see the Vehicle Maintenance Schedule Table for a list of the maintenance operations to be performed at that maintenance interval. Use the maintenance operation reference numbers to find detailed instructions in the manual for each operation.

NOTE: Maintenance instructions in this manual are based on average vehicle use and normal operating conditions. Unusual vehicle operating conditions may require service at more frequent intervals.

For specific engine maintenance information, see the *Cummins Operation and Maintenance Manual*.

IMPORTANT: Maintenance operations appearing in italics in the following tables are for emission control components. Numbers in the table are reference numbers matching those in the text of this manual.

Camp Freightliner Owner Training

Owners who want to learn more about their vehicle can attend a two-day training class, offered at the Freightliner Custom Chassis Service Center in Gaffney, South Carolina. Some of the items covered during the training include the air brake system, electrical system, vehicle storage, weight distribution, and maintenance intervals.

To learn more about the class or to register, go to **www.freightlinerchassis.com**. After entering the website, click "Motorhomes" and select "Owner Info". A class description and the registration form are located under the "Camp Freightliner" tab.

If needed, service work can be scheduled for your vehicle at the service center during your stay.

Tear-Out Checklists

IMPORTANT: Additional copies of the checklists should be made before giving this to a dealer, as they may not be returned to you. The correct number of checklists are included to cover the warranty period, however, if you want copies of the checklists for future maintenance after the warranty expires, you will need to make them. Freightliner Custom Chassis Corporation (FCCC) will not be able to send you additional copies.

At the back of the maintenance manual, there are checklists for each maintenance interval up to 60,000 miles (96 540 km). When a maintenance interval needs to be performed, take the vehicle to an authorized Freightliner dealer, remove the appropriate checklist, and give it to the dealer. These are the items that will be inspected for maintenance.

Vehicle Maintenance Schedule Table: 00–02

Maintenance Operation Procedures and Schedule																					
Maintenance Operation Number and Description	**Maintenance Interval in Miles x 1000**																				
	6	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**	**135**	**150**	**165**	**180**	**195**	**210**	**225**	**240**	**255**	**270**	**285**
	Maintenance Interval in Kilometers x 1000																				
	9	**24**	**48**	**72**	**96**	**120**	**145**	**169**	**193**	**217**	**241**	**265**	**290**	**314**	**338**	**362**	**386**	**410**	**434**	**458**	
	Maintenance Interval in Months																				
	6	**12**	**24**	**36**	**48**	**60**	**72**	**84**	**96**	**108**	**120**	**132**	**144**	**156**	**168**	**180**	**192**	**204**	**216**	**228**	
01–01 Engine Drive Belt Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
01–02 Engine-Support Fasteners Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
09–01 Air Cleaner Inspection and Replacement	When first purchased, if the Recreational Vehicle is older than the current model year, replace the air filter. Inspect the air cleaner every 12 months. Replace the air filter every 24 months, or when filter restriction exceeds the value shown in **09–01** (if equipped with an air restriction gauge).																				
09–02 Charge Air Cooler (CAC) Inspection and Cleaning	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
13–01 Air Compressor Inspection		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
15–01 Alternator, Battery, and Starter Connections Check	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
20–01 Radiator Cap Check	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
20–02 Radiator Inspection and Cleaning	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
20–03 Coolant Replacement	The coolant replacement interval is every 100,000 miles (160 900 km) or 60 months, whichever comes first. You must check and, if necessary, recharge the supplemental coolant additive (SCA) levels and freeze point every 25,000 miles (40 225 km) or 6 months, whichever comes first. See the applicable engine operation and maintenance manual for further information.																				
20–04 Mechanical Fan Drive Gearbox Oil Change	•		•		•		•		•		•		•		•		•		•		
20–05 Mechanical Fan Drive Gearbox Lubrication		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
26–01 Transmission Breather Checking		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
26–02 Allison MD/MH Series Transmission Fluid Level Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
26–03 Allison Transmission Fluid and Filter Changing (internal/ external filter)	For oil and filter change intervals, see the applicable Allison Operator's Manual.																				
30–01 Throttle Pedal Pivot Pin Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
32–01 Suspension Fastener Torque Check	•		•		•		•		•		•		•		•		•		•		
32–02 Suspension Height Control Valve Check	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	

Vehicle Maintenance Schedule Table: 00–02

Maintenance Operation Procedures and Schedule																				
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																			
	6	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285
	Maintenance Interval in Kilometers x 1000																			
	9	24	48	72	96	120	145	169	193	217	241	265	290	314	338	362	386	410	434	458
	Maintenance Interval in Months																			
	6	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228
32–03 Neway Suspension Inspection	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
32–04 ZF IFS Lubrication	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
32–05 Suspension Inspection	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
32–06 Suspension U-Bolt Torque Check	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
32–07 V-Ride Rear Suspension Inspection	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
33–01 Knuckle Pin Lubricating*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
33–02 Tie-Rod End Lubricating and Inspecting*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
33–03 All-Axle Alignment Checking	•																			
33–04 Wheel End Inspection	•	•		•		•		•		•		•		•		•		•		•
33–05 Oil-Filled Hubs Oil Level Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
33–06 Oil-Filled Hubs Oil Changing		•		•		•		•		•		•		•		•		•		•
35–01 Axle Lubricant Level Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
35–02 Axle Lubricant Changing and Magnetic Plug Cleaning	For Detroit rear axles with petroleum-based oil, change the lubricant every 100,000 miles (160 900 km) or every 12 months, whichever comes first; if synthetic oil is used, change the lubricant every 250,000 miles (402 250 km) or every 36 months, whichever comes first. For Meritor rear axles with petroleum-based oil, change the lubricant at 100,000 miles (160 900 km) or at 12 months of service, whichever comes first, and every 24 months thereafter; if synthetic oil is used, change the lubricant every 250,000 miles (402 250 km) or every 36 months, whichever comes first.																			
35–03 Axle Breather Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
35–04 Oil-Filled Hubs Oil Level Checking, Tag Axle	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
35–05 Oil-Filled Hubs Oil Changing, Tag Axle		•		•		•		•		•		•		•		•		•		•
40–01 Wheel Nut Checking	•		•		•		•		•		•		•		•		•		•	
40–02 Wheel Cleaning and Polishing	Perform these steps each time the wheels and/or the vehicle is washed.																			
41–01 Driveline Inspection and Lubrication	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
42–01 Brake System Valves Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Vehicle Maintenance Schedule Table: 00–02

Maintenance Operation Procedures and Schedule																					
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																				
	6	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	
	Maintenance Interval in Kilometers x 1000																				
	9	24	48	72	96	120	145	169	193	217	241	265	290	314	338	362	386	410	434	458	
	Maintenance Interval in Months																				
	6	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	
42–02 Air Dryer Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
42–03 Air Dryer Desiccant and Coalescent Filter Replacing				•			•			•			•			•			•		
42–04 Camshaft Bracket Bushing Lubricating		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
42–05 Slack Adjuster Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
42–06 Foot Brake Valve Actuator Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
42–07 Bendix Hydro-Max® Brake System Inspecting (front-engine diesel chassis)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
42–08 Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	Lubricate every 6 months OR every 18,000 miles (28 962 km), whichever comes first.																				
42–09 Brake Lines Checking, Hydraulic Disc or Air Brakes	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
42–10 Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine diesel chassis)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
42–11 Brake Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
42–12 Meritor Roller Pin Lubricating		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
46–01 Drag Link Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
46–02 Power Steering Reservoir Fluid Level Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
46–03 Power Steering Fluid and Filter Changing		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
46–04 Steering Driveline Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
46–05 Steering Gear Lubricating	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
46–06 Hydraulic Reservoir Filter Changing (metal reservoir only)	•		•		•		•		•		•		•		•		•		•		
47–01 Fuel Tank Mounts and Fuel Line Checking	•		•		•		•		•		•		•		•		•		•		
47–02 Fuel/Water Separator Element Replacing	See the applicable engine operation and maintenance manual for fuel/water separator element replacing intervals.																				

Vehicle Maintenance Schedule Table: 00–02

Maintenance Operation Procedures and Schedule																					
Maintenance Operation Number and Description	Maintenance Interval in Miles x 1000																				
	6	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	
	Maintenance Interval in Kilometers x 1000																				
	9	24	48	72	96	120	145	169	193	217	241	265	290	314	338	362	386	410	434	458	
	Maintenance Interval in Months																				
	6	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	
49–01 *Exhaust System Inspecting (Noise Emission Control)*	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
54–01 Ground Cables Checking and Cleaning	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
54–02 Battery Voltage Checking	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
83–01 Air Conditioner Inspecting	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	

* For vehicles with Detroit axles, complete this procedure once a year or every 25,000 miles (40 000 km), whichever comes first.

Table 1, Maintenance Operation Procedures and Schedule

6000 Mile or 6 Month Initial Maintenance: 00–03

Procedure Performed (check off or initial)	6000 Mile (9654 km) or 6 Month Initial Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Inspect _____	Charge Air Cooler (CAC) Inspection and Cleaning (if cleaning is needed)	09–02
Check _____	Alternator, Battery, and Starter Connections Check	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Change _____	Mechanical Fan Drive Gearbox Oil Change	20–04
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Check _____	Suspension Fastener Torque Check	32–01
Check _____	Suspension Height Control Valve Check	32–02
Lubricate _____	ZF IFS Lubrication	32–04
Check _____	Suspension U-Bolt Torque Check	32–06
Inspection_____	V-Ride Rear Suspension Inspection	32–07
Lubricate _____	Knuckle Pin Lubricating†	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting†	33–02
Check _____	All-Axle Alignment Checking	33–03
Inspect _____	Wheel End Inspecting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Changing (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing and Magnetic Plug Cleaning (Detroit and Meritor axles)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Wheel Nut Checking	40–01
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspection and Lubrication	41–01
Inspect _____	Brake System Valves Inspecting	42–01
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04

6000 Mile or 6 Month Initial Maintenance: 00–03

Procedure Performed (check off or initial)	6000 Mile (9654 km) or 6 Month Initial Maintenance*	MOP
Lubricate _____	Slack Adjuster Lubricating	42–05
Lubricate _____	Foot Brake Valve Actuator Lubricating	42–06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42–07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42–08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42–09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42–10
Inspect _____	Brake Inspecting (air brakes)	42–11
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46–01
Lubricate _____	Steering Driveline Lubricating	46–04
Lubricate _____	Steering Gear Lubricating	46–05
Change _____	Hydraulic Reservoir Filter Changing (including TRW)	46–06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47–01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49–01
Check _____	Ground Cables Checking and Cleaning	54–01
Inspect _____	Air Conditioner Component Inspection	83–01
Customer‡_____ Date _____		

* Additional copies are available on the Freightliner Custom Chassis Corporation website (**www.freightlinerchassis.com**).

† For vehicles with Detroit axles, complete this procedure once a year or every 25,000 miles (40 000 km), whichever comes first.

‡ Your signature on this form indicates that you have reviewed and agree to the service items to be performed. Any items you wish to exclude should be indicated with a "no" to the left of that service item.

15,000 Mile or 12 Month Maintenance: 00–04

Procedure Performed (check off or initial)	15,000 Mile (24 135 km) or 12 Month Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Inspect _____	Air Cleaner Inspection	09–01
Inspect _____	Charge Air Cooler (CAC) Inspection and Cleaning (if cleaning is needed)	09–02
Inspect _____	Air Compressor Inspection	13–01
Check _____	Alternator, Battery, and Starter Connections Check	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Lubricate _____	Mechanical Fan Drive Gearbox Lubrication	20–05
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Check _____	Suspension Fastener Torque Check	32–01
Check _____	Suspension Height Control Valve Check	32–02
Lubricate _____	ZF IFS Lubrication	32–04
Check _____	Suspension U-Bolt Torque Check	32–06
Inspection_____	V-Ride Rear Suspension Inspection	32–07
Lubricate _____	Knuckle Pin Lubricating†	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting†	33–02
Inspect _____	Wheel End Inspecting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Changing (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing and Magnetic Plug Cleaning (Detroit and Meritor axles)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspection and Lubrication	41–01
Inspect _____	Brake System Valves Inspecting	42–01
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04

15,000 Mile or 12 Month Maintenance: 00–04

Procedure Performed (check off or initial)	15,000 Mile (24 135 km) or 12 Month Maintenance*	MOP
Lubricate _____	Slack Adjuster Lubricating	42–05
Lubricate _____	Foot Brake Valve Actuator Lubricating	42–06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42–07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42–08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42–09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42–10
Inspect _____	Brake Inspecting (air brakes)	42–11
Lubricate _____	Meritor Roller Pin Lubricating	42–12
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46–01
Change _____	Power Steering Fluid and Filter Changing	46–03
Lubricate _____	Steering Driveline Lubricating	46–04
Lubricate _____	Steering Gear Lubricating	46–05
Change _____	Hydraulic Reservoir Filter Changing (including TRW)	46–06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47–01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49–01
Check _____	Ground Cables Checking and Cleaning	54–01
Inspect _____	Air Conditioner Component Inspection	83–01
Customer‡_____	Date _____	

* Additional copies are available on the Freightliner Custom Chassis Corporation website (**www.freightlinerchassis.com**).

† For vehicles with Detroit axles, complete this procedure once a year or every 25,000 miles (40 000 km), whichever comes first.

‡ Your signature on this form indicates that you have reviewed and agree to the service items to be performed. Any items you wish to exclude should be indicated with a "no" to the left of that service item.

30,000 Mile or 24 Month Maintenance: 00–05

Procedure Performed (check off or initial)	30,000 Mile (48 270 km) or 24 Month Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Change _____	Air Cleaner Replacement	09–01
Inspect _____	Charge Air Cooler (CAC) Inspection and Cleaning (if cleaning is needed)	09–02
Inspect _____	Air Compressor Inspection	13–01
Check _____	Alternator, Battery, and Starter Connections Check	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Change _____	Mechanical Fan Drive Gearbox Oil Change	20–04
Lubricate _____	Mechanical Fan Drive Gearbox Lubrication	20–05
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Check _____	Suspension Fastener Torque Check	32–01
Check _____	Suspension Height Control Valve Check	32–02
Lubricate _____	ZF IFS Lubrication	32–04
Check _____	Suspension U-Bolt Torque Check	32–06
Inspection_____	V-Ride Rear Suspension Inspection	32–07
Lubricate _____	Knuckle Pin Lubricating†	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting†	33–02
Inspect _____	Wheel End Inspecting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Changing (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing and Magnetic Plug Cleaning (Detroit and Meritor axles)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Wheel Nut Checking	40–01
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspection and Lubrication	41–01
Inspect _____	Brake System Valves Inspecting	42–01

30,000 Mile or 24 Month Maintenance: 00–05

Procedure Performed (check off or initial)	30,000 Mile (48 270 km) or 24 Month Maintenance*	MOP
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04
Lubricate _____	Slack Adjuster Lubricating	42–05
Lubricate _____	Foot Brake Valve Actuator Lubricating	42–06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42–07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42–08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42–09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42–10
Inspect _____	Brake Inspecting (air brakes)	42–11
Lubricate _____	Meritor Roller Pin Lubricating	42–12
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46–01
Change _____	Power Steering Fluid and Filter Changing	46–03
Lubricate _____	Steering Driveline Lubricating	46–04
Lubricate _____	Steering Gear Lubricating	46–05
Change _____	Hydraulic Reservoir Filter Changing (including TRW)	46–06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47–01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49–01
Check _____	Ground Cables Checking and Cleaning	54–01
Inspect _____	Air Conditioner Component Inspection	83–01
Customer‡_____ Date _____		

* Additional copies are available on the Freightliner Custom Chassis Corporation website (**www.freightlinerchassis.com**).

† For vehicles with Detroit axles, complete this procedure once a year or every 25,000 miles (40 000 km), whichever comes first.

‡ Your signature on this form indicates that you have reviewed and agree to the service items to be performed. Any items you wish to exclude should be indicated with a "no" to the left of that service item.

45,000 Mile or 36 Month Maintenance: 00–06

Procedure Performed (check off or initial)	45,000 Mile (72 405 km) or 36 Month Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Inspect _____	Air Cleaner Inspection	09–01
Inspect _____	Charge Air Cooler (CAC) Inspection and Cleaning (if cleaning is needed)	09–02
Inspect _____	Air Compressor Inspection	13–01
Check _____	Alternator, Battery, and Starter Connections Check	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Lubricate _____	Mechanical Fan Drive Gearbox Lubrication	20–05
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Check _____	Suspension Fastener Torque Check	32–01
Check _____	Suspension Height Control Valve Check	32–02
Lubricate _____	ZF IFS Lubrication	32–04
Check _____	Suspension U-Bolt Torque Check	32–06
Inspection_____	V-Ride Rear Suspension Inspection	32–07
Lubricate _____	Knuckle Pin Lubricating†	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting†	33–02
Inspect _____	Wheel End Inspecting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Changing (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing and Magnetic Plug Cleaning (Detroit and Meritor axles)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspection and Lubrication	41–01
Inspect _____	Brake System Valves Inspecting	42–01
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02
Change _____	Air Dryer Desiccant and Coalescent Filter Replacing	43–03

45,000 Mile or 36 Month Maintenance: 00–06

Procedure Performed (check off or initial)	45,000 Mile (72 405 km) or 36 Month Maintenance*	MOP
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04
Lubricate _____	Slack Adjuster Lubricating	42–05
Lubricate _____	Foot Brake Valve Actuator Lubricating	42–06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42–07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42–08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42–09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42–10
Inspect _____	Brake Inspecting (air brakes)	42–11
Lubricate _____	Meritor Roller Pin Lubricating	42–12
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46–01
Change _____	Power Steering Fluid and Filter Changing	46–03
Lubricate _____	Steering Driveline Lubricating	46–04
Lubricate _____	Steering Gear Lubricating	46–05
Change _____	Hydraulic Reservoir Filter Changing (including TRW)	46–06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47–01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49–01
Check _____	Ground Cables Checking and Cleaning	54–01
Inspect _____	Air Conditioner Component Inspection	83–01
Customer‡_____ Date _____		

* Additional copies are available on the Freightliner Custom Chassis Corporation website (**www.freightlinerchassis.com**).

† For vehicles with Detroit axles, complete this procedure once a year or every 25,000 miles (40 000 km), whichever comes first.

‡ Your signature on this form indicates that you have reviewed and agree to the service items to be performed. Any items you wish to exclude should be indicated with a "no" to the left of that service item.

60,000 Mile or 48 Month Maintenance: 00–07

Procedure Performed (check off or initial)	60,000 Mile (96 540 km) or 48 Month Maintenance*	MOP
Inspect _____	Engine Drive Belt Inspecting	01–01
Check _____	Engine-Support Fasteners Checking	01–02
Change _____	Engine Oil and Filter (see the engine manufacturer's manual)	—
Change _____	Air Cleaner Replacement	09–01
Inspect _____	Charge Air Cooler (CAC) Inspection and Cleaning (if cleaning is needed)	09–02
Inspect _____	Air Compressor Inspection	13–01
Check _____	Alternator, Battery, and Starter Connections Check	15–01
Inspect/ Check _____	Radiator (radiator cap, coolant freeze points, SCA levels, hose routing for chaffing and leaks)	20–01, 20–02, 20–03
Change _____	Mechanical Fan Drive Gearbox Oil Change	20–04
Lubricate _____	Mechanical Fan Drive Gearbox Lubrication	20–05
Change _____	Transmission Fluid and Filter (if required by Allison)	26–03
Inspect _____	Transmission Hose Routing for Chaffing and Leaks	—
Lubricate _____	Throttle Pedal Pivot Pin Lubricating	30–01
Check _____	Suspension Fastener Torque Check	32–01
Check _____	Suspension Height Control Valve Check	32–02
Lubricate _____	ZF IFS Lubrication	32–04
Check _____	Suspension U-Bolt Torque Check	32–06
Inspection_____	V-Ride Rear Suspension Inspection	32–07
Lubricate _____	Knuckle Pin Lubricating†	33–01
Lubricate _____	Tie-Rod End Lubricating and Inspecting†	33–02
Inspect _____	Wheel End Inspecting	33–04
Check/ Change _____	Oil-Filled Hubs Oil Changing (front and tag axle)	33–05, 33–06, 35–04, 35–05
Check _____	Axle Seals for Leaks	—
Change _____	Axle Lubricant Changing and Magnetic Plug Cleaning (Detroit and Meritor axles)	35–02
Check _____	Axle Breather Checking	35–03
Check _____	Wheel Nut Checking	40–01
Check _____	Tire Pressure	—
Lubricate _____	Driveline Inspection and Lubrication	41–01
Inspect _____	Brake System Valves Inspecting	42–01

60,000 Mile or 48 Month Maintenance: 00–07

Procedure Performed (check off or initial)	60,000 Mile (96 540 km) or 48 Month Maintenance*	MOP
Inspect _____	Air Dryer and Air Lines for Proper Routing, Chaffing, and Leaks	42–02
Lubricate _____	Camshaft Bracket Bushing Lubricating	42–04
Lubricate _____	Slack Adjuster Lubricating	42–05
Lubricate _____	Foot Brake Valve Actuator Lubricating	42–06
Inspect _____	Bendix Hydro-Max® Brake System Inspecting (front-engine only)	42–07
Lubricate _____	Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)	42–08
Check _____	Brake Lines Checking, Hydraulic Disc or Air Brakes	42–09
Check _____	Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine only)	42–10
Inspect _____	Brake Inspecting (air brakes)	42–11
Lubricate _____	Meritor Roller Pin Lubricating	42–12
Drain _____	Air Tanks	—
Lubricate _____	Drag Link Lubricating	46–01
Change _____	Power Steering Fluid and Filter Changing	46–03
Lubricate _____	Steering Driveline Lubricating	46–04
Lubricate _____	Steering Gear Lubricating	46–05
Change _____	Hydraulic Reservoir Filter Changing (including TRW)	46–06
Inspect _____	Fuel Tank Mounts and Fuel Line Checking	47–01
Change _____	Fuel Filters	—
Inspect _____	Exhaust System Inspecting	49–01
Check _____	Ground Cables Checking and Cleaning	54–01
Inspect _____	Air Conditioner Component Inspection	83–01
Customer‡_____ Date _____		

* Additional copies are available on the Freightliner Custom Chassis Corporation website (**www.freightlinerchassis.com**).

† For vehicles with Detroit axles, complete this procedure once a year or every 25,000 miles (40 000 km), whichever comes first.

‡ Your signature on this form indicates that you have reviewed and agree to the service items to be performed. Any items you wish to exclude should be indicated with a "no" to the left of that service item.

Noise Emission Control Maintenance

Federal Law, Part 205: Transportation Equipment Noise Emission Controls

Part 205, Transportation Equipment Noise Emission Controls, requires the vehicle manufacturer to furnish, with each new vehicle, such written instructions for the proper maintenance, use, and repair of the vehicle by the ultimate purchaser to provide reasonable assurance of the elimination or minimization of noise-emission-control degradation throughout the life of the vehicle. In compliance with the law, the noise emission controls maintenance information in each applicable group of this manual, in conjunction with the chassis workshop manual, provides these instructions to owners.

Recommendations for Replacement Parts

Replacement parts used for maintenance or repair of noise emission controls should be genuine Freightliner Custom Chassis Corporation (FCCC) parts. If other than genuine FCCC parts are used for replacement or repair of components affecting noise emission control, the owner should be sure that such parts are warranted by their manufacturer to be equivalent to genuine FCCC parts in performance and durability.

Freightliner Noise Emission Controls Warranty

See the vehicle owner's warranty information book for warranty information concerning noise emission controls.

Tampering With Noise Controls is Prohibited

Federal law prohibits the following acts or the causing thereof:

1. The removal or rendering inoperative by any person (other than for purposes of maintenance, repair, or replacement) of any device or element of design incorporated into any new vehicle for the purpose of noise control, prior to its sale or delivery to the ultimate purchaser, or while it is in use.
2. The use of the vehicle after such device or element of design has been removed or rendered inoperative by any person.

   Among those acts presumed to constitute tampering are the acts listed below:

   A. Removal of, or rendering inoperative, the engine speed governor so as to allow engine speed to exceed manufacturer's specifications.

   B. Removal of, or rendering inoperative, the fan clutch, including bypassing the control on any thermostatic fan drive to cause it to operate continuously.

   C. Removal of the fan shroud.

   D. Removal of, or rendering inoperative, exhaust components, including exhaust pipe clamping.

   E. Removal of air intake components.

Maintenance Instructions

Scheduled intervals are in the maintenance table in this group. A "Verification of Inspections Log (Group 49)" follows, and should be filled in each time noise emission controls on the vehicle are maintained or repaired.

Verification of Inspections Log

Verification of Inspections Log, Group 49				
Date	**Mileage**	**Item**	**Cost**	**Maintenance Facility**
Group 49—Exhaust System Components				

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Engine Drive Belt Inspecting	01–01
Engine-Support Fasteners Checking	01–02
Safety Precautions	

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

01–01 Engine Drive Belt Inspecting

⚠ WARNING

The engine and the belt must be cool before you check the belt. Handling a hot belt can cause personal injury.

1. Inspect the belt for damage.

   Transverse (across the belt width) cracks are acceptable.

   Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable.

2. Replace the belt if it has unacceptable cracks, is frayed, or has pieces of material missing.

   For additional information, see the *Cummins Operation and Maintenance Manual*.

01–02 Engine-Support Fasteners Checking

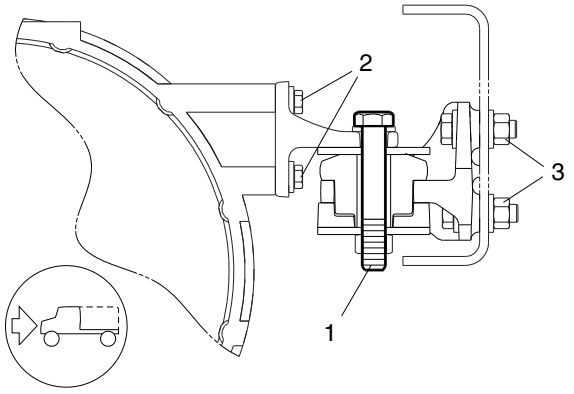
1. Check the rear engine-support fasteners. See **Fig. 1**. Tighten the rear engine-mount bolt 157 lbf·ft (213 N·m).

   Tighten the insulator-to-frame mount bracket bolts 91 lbf·ft (123 N·m).

   Tighten the engine mount bracket-to-engine bolts 62 lbf·ft (84 N·m).

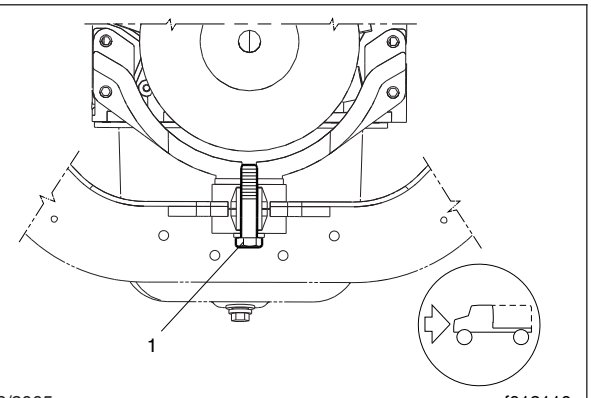
2. Check the 3/4–10 front-engine front mount bolt. See **Fig. 2**. Tighten it 95 lbf·ft (128 N·m).

   Check the 3/4–10 rear-engine front mount bolt. Tighten it 95 lbf·ft (128 N·m).



1. Front and Rear-Engine Rear Mount Bolt
2. Engine Mount Bracket-to-Engine Bolts
3. Frame Mount Bracket Bolts

Fig. 1, Front and Rear-Engine Rear Mount (ISB chassis built after 2002)



1. Front and Rear-Engine Front Mount Bolt

Fig. 2, Front and Rear-Engine Front Mount (ISB chassis built after 2002)

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Cleaner Inspection and Replacement	09–01
Charge Air Cooler (CAC) Inspection and Cleaning	09–02
Safety Precautions	

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

09–01 Air Cleaner Inspection and Replacement

NOTICE

Do not use aftermarket air-cleaner elements. Aftermarket air-cleaner elements may not seal the housing correctly, which can lead to engine damage and potentially the loss of warranty. When replacing an air-cleaner element, use only the part listed in PartsPro for the serial number of the vehicle.

IMPORTANT: When first purchased, if the Recreational Vehicle is older than the current model year, replace the air filter.

Due to the variety of possible driving conditions (dirt roads, paved roads, etc.), it is critical to check the air restriction indicator, if so equipped. If the vehicle is not equipped with an air restriction indicator, inspect all components of the air intake system and air filter every 12 months. Replace the air filter every 24 months, or when filter restriction equals or exceeds the maximum allowable restriction. **More frequent inspections and/or filter replacement may be needed if your vehicle is being operated in a dusty environment, to avoid damaging the vehicle.**

NOTE: Remove and visually inspect the air filter for obvious damage such as holes, cuts, or dents. Remove loose debris, such as leaves or pine needles, from the filter housing.

Inspect the air cleaner and plumbing for holes or tears at the recommended interval. If the air cleaner is damaged, replace it. See **Group 09** of the *Recreational Vehicle Chassis Workshop Manual* for removal and installation procedures, or take the vehicle to an authorized Freightliner dealer. A typical air cleaner mounting is shown in **Fig. 1**.

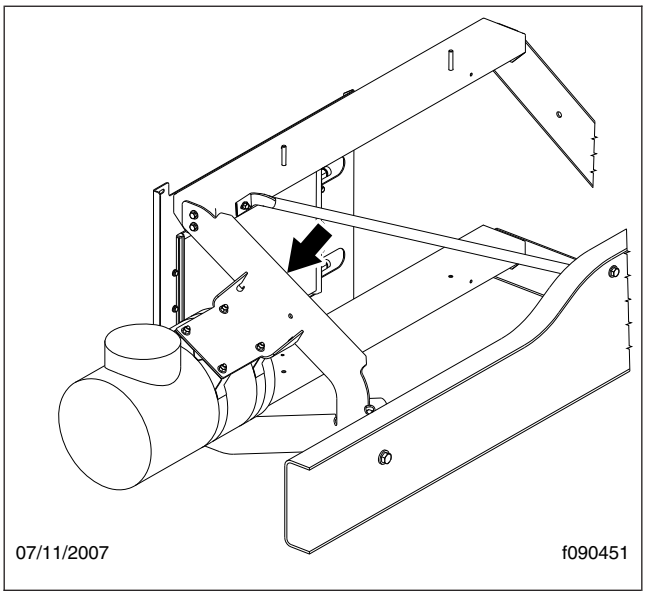


Fig. 1, Air Cleaner Mounting

Engine damage can occur if the air intake system is not properly maintained. Use the air intake restriction indicator to check for air intake system damage or leaks. See **Fig. 2**. Make sure the engine is off and note the existing reading on the indicator. Reset the indicator by pushing it down. See **Fig. 2**. Start the engine and take a short test drive. Check the indicator again and note the level of restriction on the indicator, verifying it is at the same level as seen earlier. A decrease from the previous level of restriction or a very low air restriction indicator reading (0 to 4 inH_2O) could indicate an air intake system problem such as a damaged air filter, loose or disconnected air intake piping, or a disconnected or damaged air restriction indicator.

Replace the air filter at the recommended interval, or when filter restriction equals or exceeds the maximum allowable restriction. See the *Recreational Vehicle Chassis Operator's Manual* for specific restriction values for your engine. See **Group 09** of the *Recreational Vehicle Chassis Workshop Manual* for removal and installation procedures, or take the vehicle to an authorized Freightliner dealer.

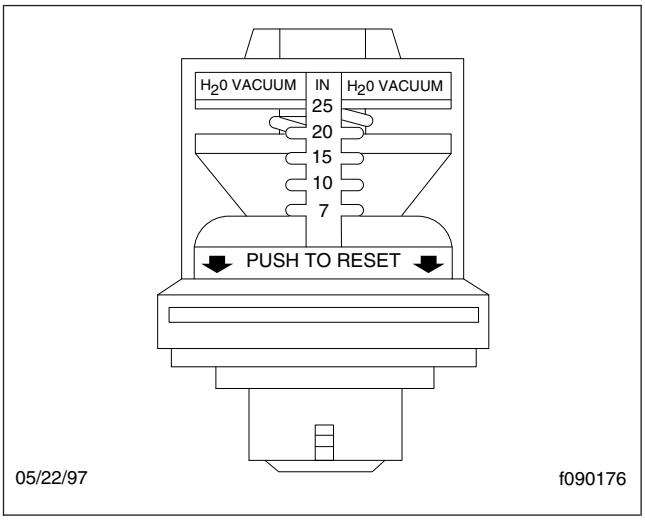


Fig. 2, Air Restriction Indicator

09–02 Charge Air Cooler (CAC) Inspection and Cleaning

Good airflow through the CAC core is essential for proper engine cooling. The cores allow air passage, but form a barrier that tends to collect insects and airborne debris.

Inspect the CAC hoses for chafing and cracks that will allow an air leak. Replace the hoses as needed. Inspect the CAC for clogging or damage and clean and/or repair it if necessary. Soak the CAC with a non-corrosive degreaser such as Simple Green. Let the unit sit for several minutes to work through the CAC. Using low water pressure directed from the fan side of the radiator core, rinse the CAC; be careful not to damage or bend the fins. Depending on the condition of the CAC, this process may have to be performed several times.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Compressor Inspection	13–01
Safety Precautions	

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

13–01 Air Compressor Inspection

1. Inspect the air compressor intake hoses and connections at the air intake and air compressor for physical damage. If needed, change the hoses, and/or tighten or replace the connections.
2. Inspect the coolant supply and return lines for tight connections. Tighten the connections and replace the lines and fasteners if needed.
3. For the air governor, inspect the piping and connections for leaks. Replace gaskets and faulty components as needed.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Alternator, Battery, and Starter Connections Check	15–01
Safety Precautions	

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

15–01 Alternator, Battery, and Starter Connections Check

⚠ WARNING

Batteries release explosive gas as a by-product of their chemical activity. Do not smoke when working around batteries. Put out all flames and remove any source of sparks or intense heat. Make sure the battery compartment is completely vented before disconnecting or connecting the battery cables.

Battery acid is extremely harmful if splashed in the eyes or on the skin. Always wear a face shield and protective clothing when working around batteries.

Damaged, chafed, or kinked wiring can cause electrical short-circuits and lead to fires, causing property damage, injury, or death. Clean, inspect, and maintain wiring and connections carefully.

1. Disconnect the batteries.
2. Check the tightness of the alternator bracket fasteners and alternator mounting fasteners; tighten the fasteners as needed. For torque values, see **Group 15** of the vehicle *Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
3. Check that all electrical connections at the alternator and starter are clean. Clean and tighten all charging system electrical connections as needed. Spray each electrical connection at the alternator and starter with dielectric red enamel.

   Trace and inspect all wiring and cables connected to:

   - alternator
   - starter and depopulation studs
   - batteries
   - magnetic switch
   - cab
   - jump-start studs
   - battery isolation relays
   - battery shutoff switches
4. Check wires and cables for wear, chafing, kinks, discolored insulation, or loose clamps or ties. Find the cause of any problems and repair, replace, and reroute wires and clamps as necessary.

IMPORTANT: Ensure that wires and cables are not near any heat sources; if they are, reroute them.

5. Clean all circuit breakers and relays.
6. Check the alternator wiring for missing insulation, kinks, and heat damage. Replace or repair as needed.
7. On the bundled cable that runs from the batteries to the starter, ensure that tie straps are installed at least every 12 inches (30 cm). Replace any missing tie straps, and add tie straps where spacing between them exceeds 12 inches (30 cm).
8. Ensure that all cables have sufficient slack to allow for engine movement, and that there is no force on any wiring connectors.
9. If any convoluted tubing is damaged, check the wiring inside it. Replace any damaged or missing convoluted tubing.
10. Inspect the battery cables for wear, and replace as needed. Clean the cable connector terminals with a wire brush. See **Group 54** of the vehicle *Workshop Manual* for troubleshooting instructions, and for adjustment, repair, or replacement instructions, or take the vehicle to an authorized Freightliner dealer.

    10.1 Clean and tighten the battery ground cable, terminal, and clamps.

    10.2 Inspect the retainer assembly (or battery hold-downs) and the battery box. Replace worn or damaged parts. Remove any cor-

rosion with a wire brush, and wash with a weak solution of baking soda and water. Rinse with clean water, then dry. Paint the retainer assembly, if needed, to prevent rusting.

10.3 Check that foreign objects, such as stones, bolts, and nuts, are removed from the battery box.

10.4 After cleaning, connect the cables to the batteries, and tighten them to the torque specifications listed on the battery, generally 10 to 15 lbf·ft (14 to 20 N·m).

10.5 Coat the battery terminals with dielectric grease.

11. Check the terminals on the battery shut-off switch and the starter relay. Make sure that the terminal connections are clean and tight. Coat the terminal connections with dielectric red enamel after cleaning.

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Title of Maintenance Operation (MOP)	MOP Number
Coolant Replacement	20–03
Mechanical Fan Drive Gearbox Lubrication	20–05
Mechanical Fan Drive Gearbox Oil Change	20–04
Radiator Cap Check	20–01
Radiator Inspection and Cleaning	20–02
Safety Precautions	

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

20–01 Radiator Cap Check

⚠ WARNING

Do not remove or loosen the radiator cap until the engine and cooling system have completely cooled. Use extreme care when removing the cap. A sudden release of pressure from removing the cap prior to the system cooling can result in a surge of scalding coolant that could cause serious personal injury.

The radiator cap is the most ignored part in the cooling system. If it is suspect, replace it. An inspection means checking the cap with a pressure tester. A radiator cap in good condition will not open below 9 psi (62 kPa). A visual check is also in order: look for signs of deterioration of the inner gasket. Also look for cracks or breaks in the spring retainer in the cap and for corrosion or deposits on the spring itself. If the spring is not in perfect condition, it has probably lost tension; replace it. See **Fig. 1**.

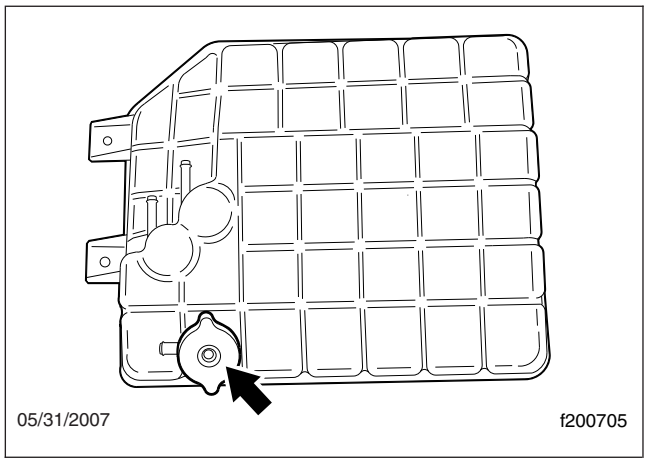


Fig. 1, Surge Tank Coolant Fill Cap

20–02 Radiator Inspection and Cleaning

Inspect the radiator for clogging or damage and clean and/or repair it if necessary. Soak the radiator with a non-corrosive degreaser such as Simple Green. Let the unit sit for several minutes to work through the radiator. Using low water pressure, rinse the radiator. Be careful not to damage or bend the fins of the radiator. Depending on the condition of the radiator, this process may have to be performed several times.

20–03 Coolant Replacement

At the intervals specified in the maintenance schedule, or whenever the coolant becomes dirty, flush and refill the cooling system.

NOTE: The coolant replacement interval is increased to 100,000 miles (161 000 km) or 60 months, whichever comes first. For this interval to apply, you must check and, if necessary, recharge the supplemental coolant additive (SCA) levels and the freeze point every 25,000 miles (40 000 km) or 6 months, whichever comes first. See the *Cummins Operation and Maintenance Manual* for further information.

⚠ WARNING

Do not remove or loosen the radiator cap until the engine and cooling system have completely cooled. Use extreme care when removing the cap. A sudden release of pressure from removing the cap prior to the system cooling can result in a surge of scalding coolant that could cause serious personal injury.

1. Drain the cooling system, as follows.
   - 1.1 When the engine is cool, remove the radiator cap.

     Turn the cap slowly counterclockwise until it reaches a "stop." Do not press down while turning the cap. Wait until any remaining pressure (indicated by a hissing sound) is relieved, then press down on the cap and continue turning it counterclockwise.

1.2 When the cap is removed, run the engine until the upper radiator hose is hot—this shows that the thermostat is open and the coolant is flowing through the system.

⚠ WARNING

Use extreme care when draining coolant that is very warm. It may still be hot enough to cause serious personal injury by scalding.

1.3 Stop the engine. Remove the lower radiator hose to drain the coolant. Drainage may be speeded by removing the plug in the bottom of the water inlet.

2. Flush the cooling system, as follows.

NOTICE

During filling, air must be vented from the engine coolant passages. Any air trapped in the system can cause severe engine damage.

2.1 Connect the lower radiator hose and install the plug in the bottom of the water inlet.

2.2 Open the engine venting petcock.

2.3 Add water to the surge tank until the system is filled.

2.4 Start the engine. Run it at low idle for 10 seconds, then at high idle for 1 minute. Return to low idle.

2.5 Close the lower petcock when a steady stream of water is flowing from it. Don't let more than 1.5 quarts (1.4 L) of water escape.

2.6 Close the upper petcock when a steady stream of water is flowing from it. Don't let more than 1.5 quarts (1.4 L) of water escape.

2.7 Repeat several times until the drained liquid is nearly colorless.

2.8 Completely drain the system, then close the radiator and block the drain valves.

2.9 Disconnect all hoses from the surge tank. Remove the tank and pour out any fluid. Scrub and clean the inside of the surge tank with soap and water. Flush it with clean water, then drain it. Install the surge tank and hoses.

IMPORTANT: On vehicles with EPA07-compliant engines, the coolant capacity varies depending on the engine and accessory installation. After servicing the cooling system, always verify that the coolant level is between the MIN and MAX lines on the surge tank.

3. Fill the cooling system, as follows.

3.1 Slowly add a 50/50 mixture of antifreeze and water to the surge tank until the system is filled. See **Table 1** for a list of approved coolants.

Approved Coolants	
Coolant Manufacturer	**Coolant Designation***
Old World Industries	Fleet Charge®
Shell	Shell HD/N Antifreeze
Texaco	JC04 Antifreeze
Van Waters and Rogers Ltd. (Canada)	Diesel Antifreeze No. 6038

* Freightliner-approved antifreeze must meet one of the following conditions: A. Ethylene glycol solution that meets GM 6038–M Engineering Standards. B. Ethylene glycol solution that has less than 0.1% anhydrous sodium metasilicate, and meets either GM 1825–M or GM 1899–M Engineering Standards.

Table 1, Approved Coolants

3.2 With the radiator cap removed, start the engine and run it at low idle for 10 seconds; then at high idle for 1 minute. Return to low idle.

3.3 Run the engine, with the radiator cap removed, until the upper radiator hose is hot. With the engine idling, add coolant to the radiator until it is between the MIN and MAX lines on the surge tank. Install the radiator cap.

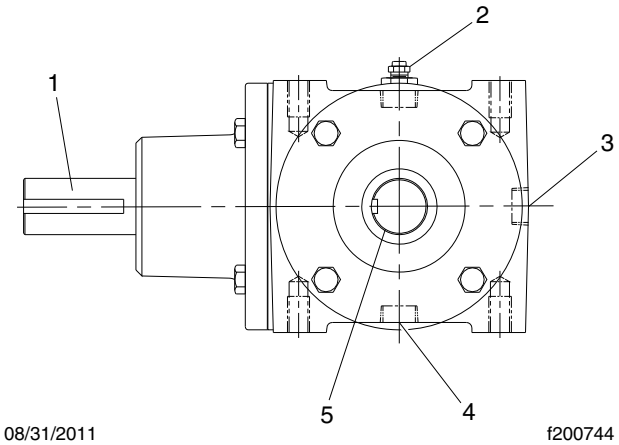
20–04 Mechanical Fan Drive Gearbox Oil Change

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.

2. Place a drain pan under the fan drive gearbox.

IMPORTANT: Label the plugs as they are removed. The breather/fill plug must always be installed in the top of the gearbox, opposite the drain plug.

3. Remove the drain plug and breather/fill plug, shown in **Fig. 2**, to begin draining the oil.



1. Pinion Shaft
2. Breather/Fill Plug
3. Oil Level Plug
4. Drain Plug
5. Cross-Shaft

Fig. 2, Mechanical Fan Drive Gearbox

4. Remove the oil level plug. See **Fig. 2**.
5. Flush the fan drive gearbox with an approved nonflammalbe, nontoxic solvent such as:
   - Lubriplate Syn Flush
   - Lubriplate Pure Flush
   - Whitmore's Flushing Oil
   - Medallion™ Flushing Oil Kosher
6. Using degreaser, clean the thread on the drain hole and drain plug.
7. Install the drain plug.
8. Fill the fan drive gearbox with Mobil® Delvac 75W–90 lubricant until the lubricant starts to come out of the oil level plug hole.
9. Using degreaser, clean the thread on the oil level and fill holes and both plugs.
10. Install the plugs, making certain that the breather/fill plug is used in the fill plug hole.

20–05 Mechanical Fan Drive Gearbox Lubrication

U-Joint Lubrication

1. Wipe all old grease and dirt from each U-joint grease fitting.
2. Use a hand-type grease gun, or a high-pressure gun with a low-pressure adaptor, to lubricate the U-joints. See **Fig. 3**.

NOTE: If a low-pressure adaptor is not used with the high-pressure gun, the U-joints may not receive enough lubricant.

3. Using lithium 12-hydroxy stearate grease (NLGI grade 2, with EP additives and meeting ASTM D4950 LB specifications), lubricate until new grease can be seen at both U-joint seals.

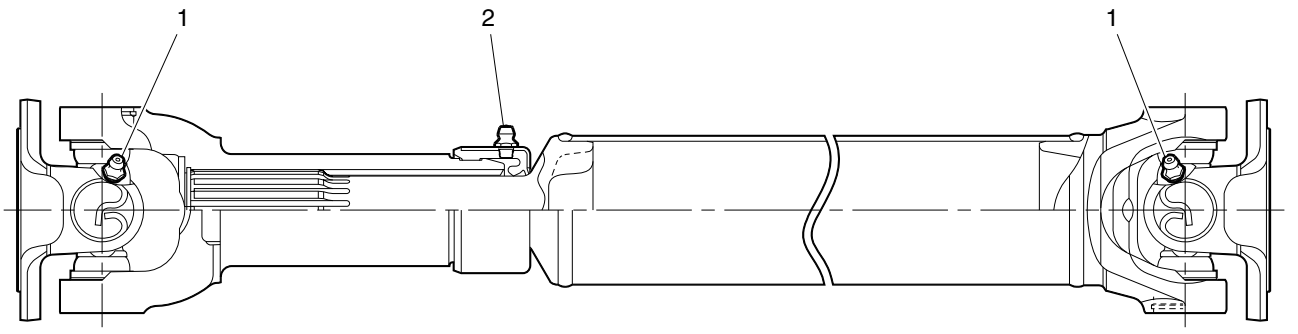
NOTICE

Fresh lubricant must be seen escaping from *both* of the bearing cup seals of each U-joint. If not, the U-joint may fail prematurely.

4. If the bearing will not take grease, replace the U-joint assembly.
5. Check the old grease. If it appears rusty, gritty, or burned, replace the U-joint assembly.
6. Wipe any excess grease from the seals and grease fittings.

Slip-Joint Spline Lubrication

1. Check the slip-joints for spline wear by trying to bend the sleeve-yoke and splined shaft back and forth. If looseness is greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.
2. Wipe all old grease and dirt from the slip-joint grease fitting.
3. Use a hand-type grease gun or a high-pressure gun with a low-pressure adaptor, to lubricate the slip-joint. See **Fig. 3**. Using lithium 12-hydroxy stearate grease (NLGI grade 2, with EP additives and meeting ASTM D4950 LB specifications), lubricate until fresh grease appears at the pressure-relief hole in the yoke plug. Then cover the relief hole with your finger, while continuing



1. U-Joint Grease Fitting
2. Slip-Joint Grease Fitting

Fig. 3, Slip-Joint and U-Joint Lubricating

to lubricate until fresh grease appears at the slip-joint seal. This ensures complete lubrication of the splines.

4. Wipe any excess grease from the pressure-relief hole, slip-joint seal, and grease fitting.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Allison MD/MH Series Transmission Fluid Level Checking	26–02
Allison Transmission Fluid and Filter Changing (internal/external filter)	26–03
Safety Precautions	
Transmission Breather Checking	26–01

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

26–01 Transmission Breather Checking

Transmission housing breathers must remain clear. A plugged breather could result in pressure build-up, which could cause lubricant leakage.

If the breather is plugged, clean or replace it. See **Fig. 1**. Check more often if the vehicle is operating under very dusty conditions.

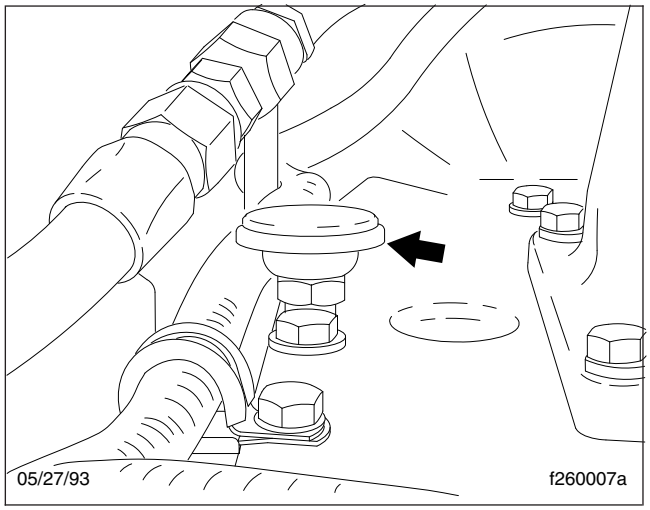


Fig. 1, Transmission Breather

26–02 Allison MD/MH Series Transmission Fluid Level Checking

Cold Check

IMPORTANT: After replacing the transmission fluid or changing the filter(s), it is important to check the fluid level cold to determine if the transmission has a sufficient amount of fluid to be safely operated until a hot check can be performed.

1. A cold check may be made when the sump temperature is 60 to 104°F (15 to 40°C).
2. Run the engine for at least one minute to clear the fluid system of air.
3. With the engine running, wipe the dipstick clean and check the fluid level. Any level within the COLD RUN (lower) band is satisfactory for operating the vehicle. See **Fig. 2**. If the level is not within the COLD RUN band, add or drain fluid until it reaches the middle of the COLD RUN band.

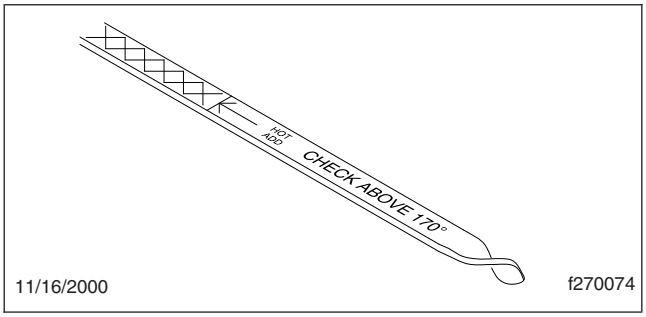


Fig. 2, Transmission Dipstick

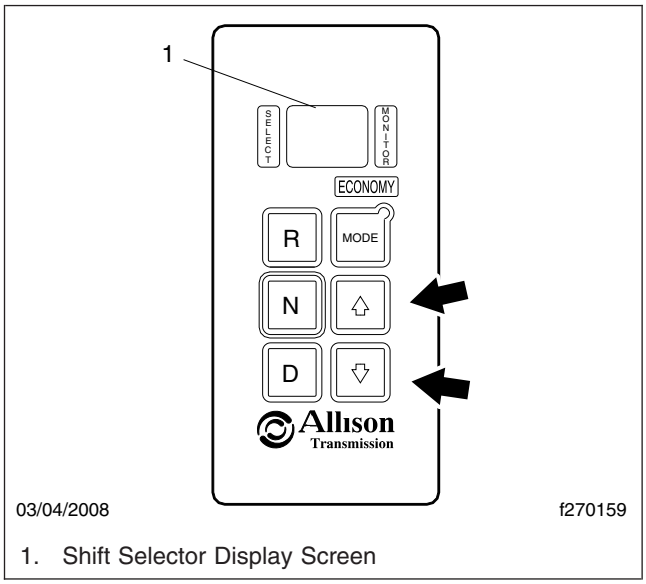
4. Perform a hot check at the first opportunity after normal operating temperature, 160 to 200°F (71 to 93°C), is reached.

Hot Check

Recommended Method

With the vehicle on a level surface and the transmission in neutral at operating temperature, perform the steps below.

1. On the transmission shift selector, press the up and down arrow keys simultaneously. See **Fig. 3**.
2. Release the arrow keys and wait for a two-minute countdown.
3. The transmission shift selector display screen will display one of the following messages.
   - OL - OK indicates an acceptable oil level.
   - OL - HI followed by a number indicates the amount that is over-filled.



1. Shift Selector Display Screen

Fig. 3, Transmission Shift Selector

- OL - LO followed by a number indicates the amount that is under-filled.
- OL - 70 indicates that the transmission is not up to operating temperature.

Alternate Method

1. Operate the transmission in a Drive (D) range until normal operating temperature, 160 to 200°F (71 to 93°C), is reached.

NOTE: The fluid must be warm to ensure an accurate check. The fluid level rises as temperature increases.

2. Park the vehicle. Shift to Neutral (N) and apply the parking brake. Let the engine run at idle.
3. Wipe the dipstick clean and check the fluid level. A safe operating level is any level within the HOT RUN (upper) band on the dipstick. See **Fig. 2**.
4. If the fluid is not within this range, add or drain fluid as needed to bring the level to the top of the HOT RUN band. See **Table 1** for approved transmission lubricants. See **Table 2** for lubricant capacities.

26–03 Allison Transmission Fluid and Filter Changing (internal/ external filter)

IMPORTANT: For oil and filter change intervals, see the applicable Allison Operator's Manual. To request a replacement Allison Operator's Manual, call 1-888-666-5799.

Oil and filter change intervals can also be found at **www.allisontransmission.com**. Choose "Service", and click "Service Tips". Then, select the appropriate transmission to view fluid and filter change recommendations.

Approved Allison Transmission Lubricants*		
TES-295 Approval Number	**Company**	**Product Brand Name**
AN-051005	ExxonMobil Lubricants and Petroleum Specialties Company	Mobil Delvac Synthetic ATF
AN-011001	Castrol Heavy Duty Lubricants	TranSynd
AN-031002	BP	Autran Syn 295
AN-031003	Cognis Corporation	Emgard 2805
AN-031004	International Truck & Engine Company	Fleetrite Synthetic ATF
AN-071006	John Deere & Company	HD SynTran

* To check the latest Allison approved fluids, go to **www.allisontransmission.com**. Lubricants listed in order of preference. Do not mix types of oil.

Table 1, Approved Allison Transmission Lubricants

Automatic Transmission Lubricant Capacities	
Model	**Refill Capacity*: qt (L)**
1000, 2000, and 2000 MH	16.0 (15.1)
3000 MH† and 4000 MH	17.5 (16.5)

* Quantities listed are approximate. Add the recommended amount of fluid as listed under refill capacity. Do not overfill.

† Some Allison 3000 MH transmissions have a deeper oil sump than other models. These models require 3 additional quarts (2.8 L) of ATF.

Table 2, Automatic Transmission Lubricant Capacities

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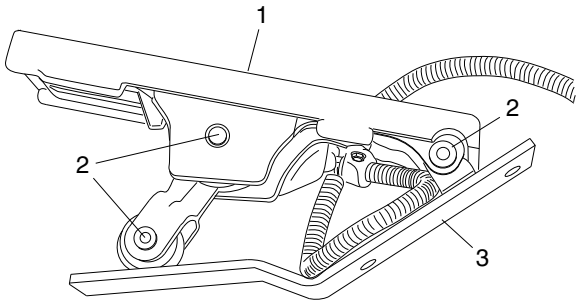
Title of Maintenance Operation (MOP)	MOP Number
Throttle Pedal Pivot Pin Lubricating	30–01

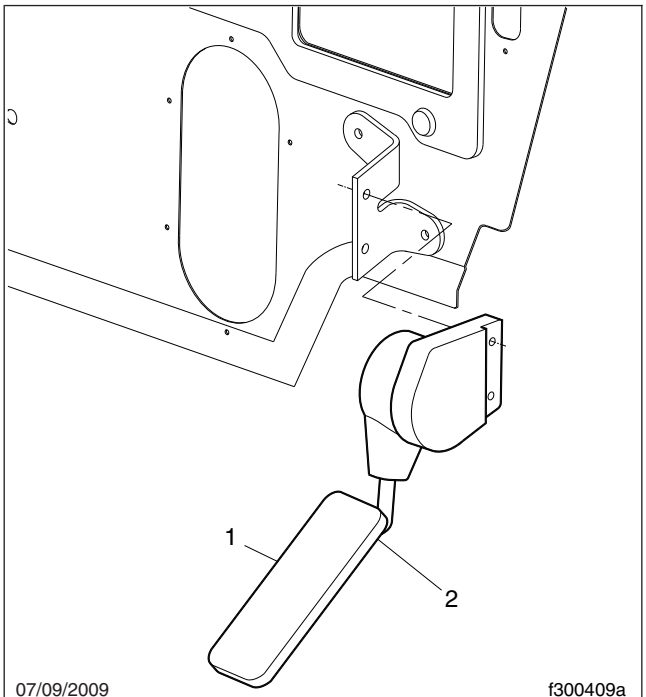
30–01 Throttle Pedal Pivot Pin Lubricating

Using a silicone spray, lubricate the throttle pedal pivot pins as shown in **Fig. 1** and **Fig. 2**.



1. Throttle Pedal Assembly
2. Pivot Pins
3. Base Plate

Fig. 1, Floor-Mounted Throttle Pedal



1. Throttle Pedal Assembly
2. Pivot Pin (not shown)

Fig. 2, Suspended Throttle Pedal

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Neway Suspension Inspection	32–03
Safety Precautions.	
Suspension Fastener Torque Check	32–01
Suspension Height Control Valve Check	32–02
Suspension Inspection	32–05
Suspension U-Bolt Torque Check	32–06
V-Ride Rear Suspension Inspection	32–07
ZF IFS Lubrication	32–04

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

32–01 Suspension Fastener Torque Check

⚠ WARNING

Inspect the suspension fasteners. Failure to perform inspections could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Chock the front or the rear tires. Working at the front of the vehicle or at the rear of the vehicle, raise the vehicle so that the tires just clear the ground and the suspension is fully extended. Place safety stands under the vehicle frame.
2. Check the suspension fasteners. See **Table 1** for correct fastener torques.
3. Check the torque of the rear axle U-bolts.

   In a diagonal pattern, tighten all 5/8–18 U-bolt nuts 205 lbf·ft (278 N·m); tighten all 3/4–16 U-bolt nuts 300 lbf·ft (407 N·m); and tighten all 7/8–14 U-bolt nuts 460 lbf·ft (624 N·m).

NOTICE

Failure to retorque the U-bolt nuts could result in spring breakage and abnormal tire wear.

4. Remove the safety stands and lower the vehicle to the ground.

32–02 Suspension Height Control Valve Check

⚠ WARNING

Inspect the height control components and check their operation. Failure to perform these inspections and checks could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Park the vehicle on a level surface. Apply the parking brake and chock the tires to prevent the vehicle from moving.
2. Inspect the front and rear suspensions for any signs of damage, loose components, wear, or cracks. Replace any damaged components to prevent failure or equipment breakdown.
3. Inspect all bolts and nuts at the pivot axle connections to assure that they are properly torqued. Check all other nuts and bolts for proper torque. See **Group 00** of this manual for proper torque specifications.
4. Check the air pressure gauge to confirm that there is in excess of 65 psi (448 kPa) in the air system, and inspect the air springs for sufficient and equal firmness.

Suspension Torque Specifications (lubricated threads)		
Description	**Size**	**Torque: lbf·ft (N·m)**
Shock Absorber Mount Locknut	3/4–16	110 to 150 (149 to 203)
Air Spring Upper Mounting Plate Locknut	3/4–16	31 to 42 (42 to 57)
Air Spring Upper Mounting Plate Capscrew	1/2–13	31 to 42 (42 to 57)
Air Spring Lower Mounting Plate Capscrew	1/2–13	31 to 42 (42 to 57)

Suspension Torque Specifications (lubricated threads)		
Description	**Size**	**Torque: lbf·ft (N·m)**
Transverse Beam Bushing Locknuts	1-1/4–12	600 to 700 (814 to 949)
Equalizing Beam Center Bushing Locknut	3/4–16	150 to 200 (203 to 271)
Equalizing Beam Front Bushing Locknut	1-1/8–12	600 to 700 (814 to 949)
	1-1/4–12	
Control Rod Ball Stud Locknut	1-1/8–12	550 to 650 (746 to 881)
Control and Torque Rod Mounting Locknuts	5/8–18	110 to 150 (149 to 203)

Table 1, Suspension Torque Specifications (lubricated threads)

NOTE: Height control valves control all front and rear suspension air springs. Check for air leaks by applying a soapy solution. Then, check for bubbles at all air connections and fittings.

5. Check the ride height of the air suspension by measuring the distance from the center of the lower shock bolt to the bottom of the frame rail. See **Fig. 1**. See **Table 2** for height control valve adjustment measurements. If ride height is incorrect, adjust the air suspension.

Height Control Valve Adjustment Measurements	
Suspension	**Measurement Inches ±1/4 (mm ±6)**
AS120 (front)	10 (254) or 10-1/2 (267)*
AS140 (front)	11 (279)
IFS114 (front)	17-1/2 (445)
IFS ZF (front)	15-3/4 (400)
ADL-RS17/19/21	10-1/4 (260)
AD200-RS17/19	9-3/4 (248)
AD200-RS15	9-3/8 (238)
ADTB280 (rear)	17-1/4 (438)
Airliner 15k (rear)	8-3/4 (222)
AD123 (rear)	18 (457)
ADL123 (rear)	11 (279)

* Some vehicles have a different shock location. When this is the case, the vehicle will have a 55 degree wheel cut. Ride height for these vehicles should be set at 10-1/2 inches (267 mm).

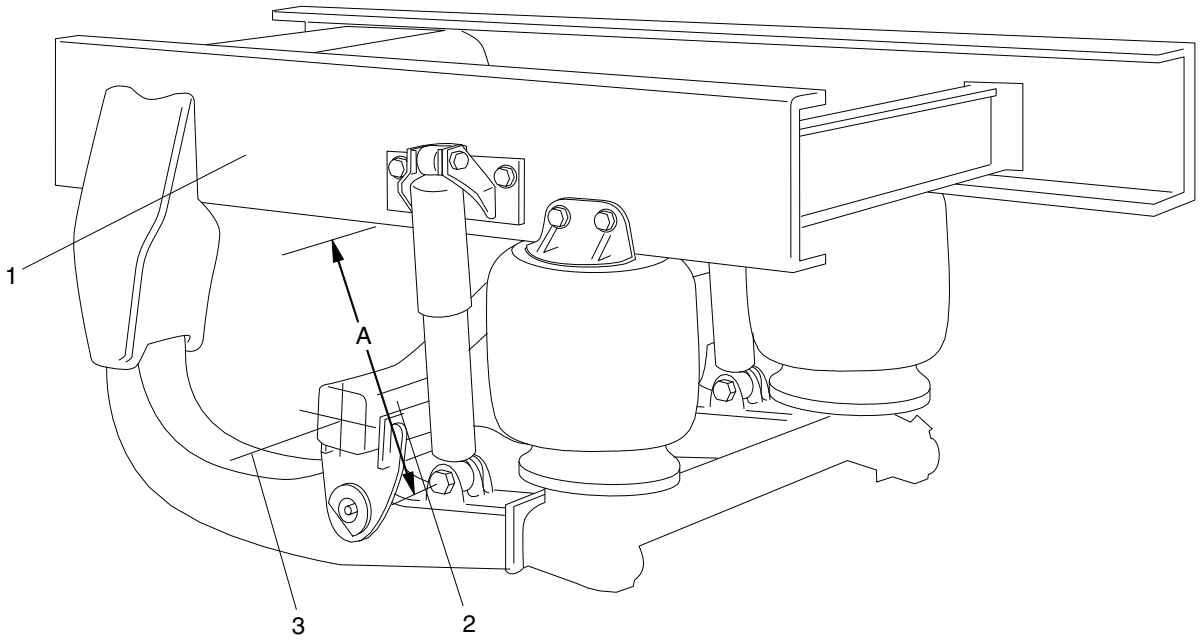
Table 2, Height Control Valve Adjustment Measurements

32–03 Neway Suspension Inspection

WARNING

Inspect the components and check their operation as described below. Failure to perform these inspections and checks could result in separation of worn suspension components and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Chock the front or the rear tires. Working at the front of the vehicle or at the rear of the vehicle, raise the vehicle so that the tires just clear the ground and the suspension is fully extended. Place safety stands under the vehicle frame.
2. Squeeze all air springs to check for complete deflation. It may take ten minutes for the pressure to bleed down from the air spring. See **Fig. 2**. If any air springs remain partially or fully inflated, see **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. Inspect the air springs for cracks, tears, or other damage.
3. Inspect each air spring for wear at the pedestal connection. Inspect for leaks at the upper and lower pedestal connections using a soapy solution. Replace any worn air springs; for instructions, see **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
4. Inspect the bolts and nuts at the pivot connections, the transverse beam connections, and the



A. Measure here for suspension ride height.
1. Frame Rail
2. Axle Housing
3. Axle Centerline

Fig. 1, Ride Height Inspection (typical Neway suspension shown)

axle connections to ensure they are tightened to the correct torque specification.

5. Check all of the other suspension components for any sign of damage, looseness, wear, or cracks. Replace worn or damaged parts. See **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
6. Inspect for cracked welds. If cracks are found, contact Neway immediately for further instructions.
7. Inspect the torque rod and track bar pivot bushings for excessive wear. Replace worn or damaged bushings. See **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
8. Move the axle up and down while checking for signs of looseness due to worn parts at the front pivot connections. Replace any worn parts by following the procedures in **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
9. Check for leaks on the height control valves by applying a soapy solution, then, watching for bubbles at all air connections and fittings.
10. Inspect the shock absorbers for oil leaks and worn rubber bushings. Replace the shock absorbers and/or rubber bushings if wear or damage is noted. For instructions, see **Group 32** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
11. Remove the safety stands and lower the vehicle to the ground. Run the engine until air pressure of at least 100 psi (689 kPa) is maintained throughout the system.

IMPORTANT: Repeat this check at both ends of the vehicle.

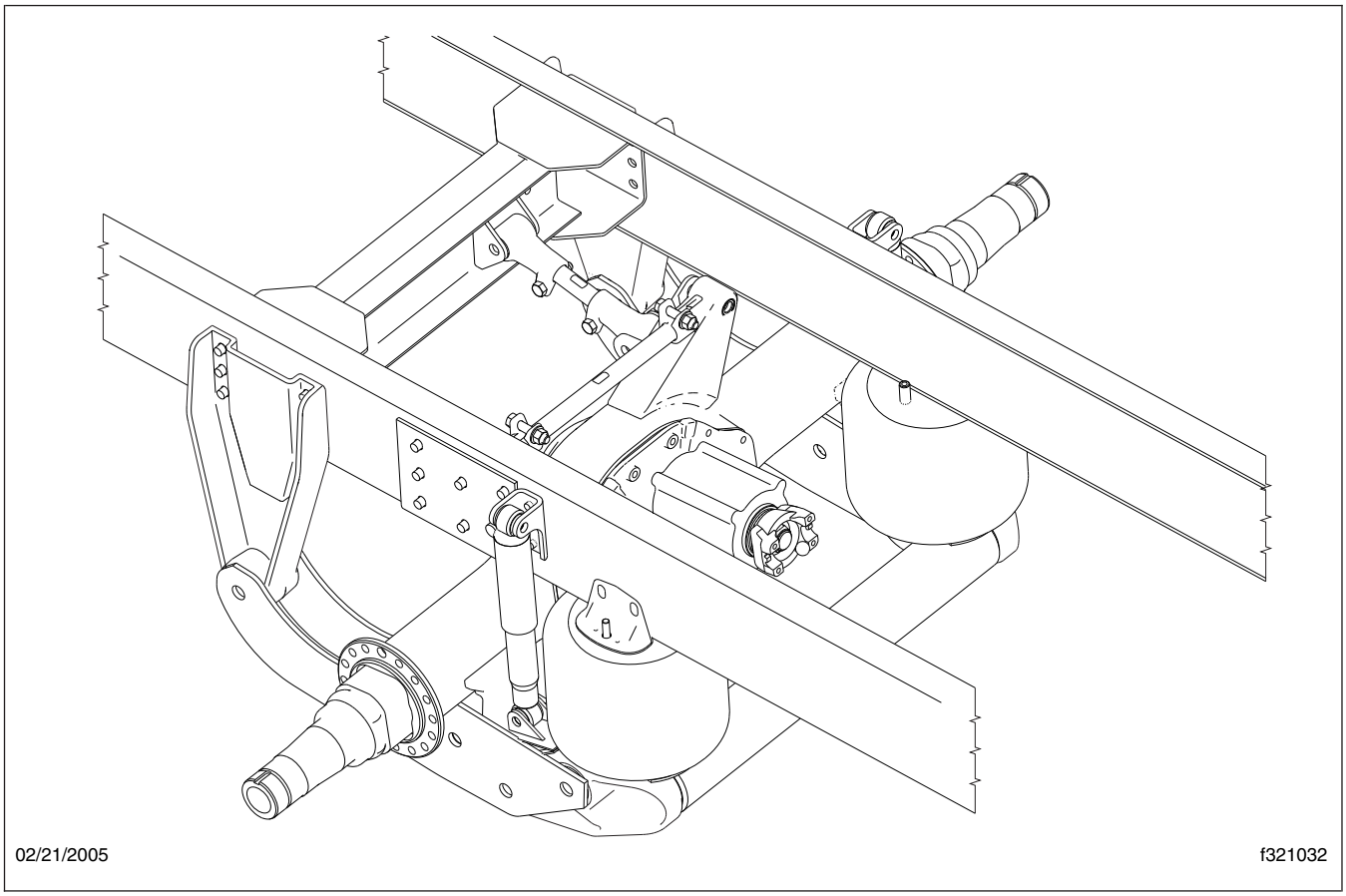


Fig. 2, Holland Neway ADL 120/123 Suspension

12. Check that all air springs are inflated. If the air springs do not inflate, see **Group 32** of the *Recreational Vehicle Chassis Workshop Manual* for possible causes and corrections, or take the vehicle to an authorized Freightliner dealer.

32–04 ZF IFS Lubrication

IMPORTANT: Do not raise the vehicle by placing a jack under the control arm(s). The weight of the vehicle could damage the control arms and cause alignment issues. See **Fig. 3** for correct jack placement.

1. Chock the rear tires and apply the parking brake. Raise the front of the vehicle with a jack so the tires just clear the ground and the suspension is fully extended. Place safety stands under the vehicle frame.

⚠ WARNING

Never work around or under a vehicle that is supported only by a jack. Always support the vehicle with safety stands. Jacks can slip, causing the vehicle to fall, which could result in serious injury or death.

IMPORTANT: Every 50,000 miles (80 450 km), ZF recommends that the wheel hub be removed to check the wheel bearing lash, and adjust as needed.

2. Remove the wheel hub. See **Group 33** of the *Recreational Vehicle Chassis Workshop Manual* for wheel bearing service procedures, or take the vehicle to an authorized Freightliner dealer.
3. Lubricate the steering knuckle/control arm at indicated maintenance intervals. Use only an NLGI

Grade 2 lithium-based grease, multipurpose grease, or mineral oil on the lubricating points. See **Fig. 4** and **Fig. 5**.

32–05 Suspension Inspection

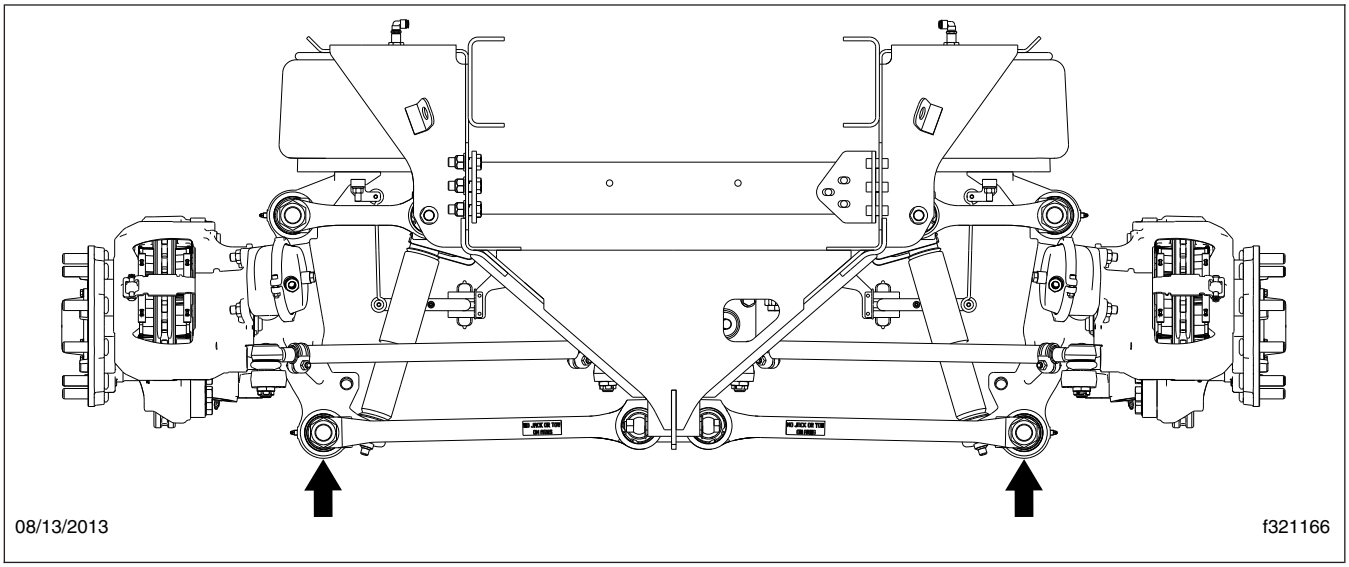
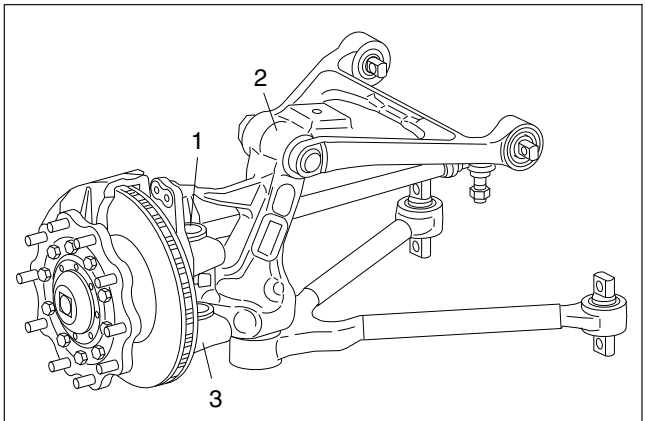
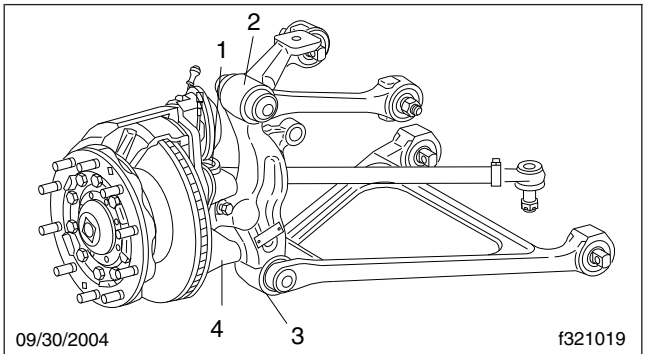


Fig. 3, ZF IFS Jack Placement



1. Steering Knuckle Bearing Grease Fitting (upper)
2. Steering Knuckle
3. Steering Knuckle Bearing Grease Fitting (lower)

Fig. 4, Pressure Grease Fitting Positions, RL-75E



1. Steering Knuckle Bearing Grease Fitting (upper)
2. Control Arm Grease Fitting (upper)
3. Control Arm Grease Fitting (lower)
4. Steering Knuckle Bearing Grease Fitting (lower)

Fig. 5, Pressure Grease Fitting Positions, RL-75EM

Freightliner Spring Front and Rear Suspension Spring Assemblies Inspection

Inspect the front and rear suspension spring assemblies for pitted, cracked, broken, or abnormally bent leaves and extreme rust. If any of these conditions

exist, replace the spring assembly. See **Group 32** of the *Recreational Vehicle Chassis Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

⚠ WARNING

Do not replace individual leaves of a damaged leaf spring assembly; replace the complete spring assembly. Visible damage (cracks or breaks) to one leaf causes hidden damage to other leaves. Replacement of only the visibly damaged part(s) is no assurance that the spring is safe. On front spring assemblies, if cracks or breaks exist in the two top leaves, a loss of vehicle control could occur. Failure to replace a damaged spring assembly could cause an accident resulting in property damage, serious personal injury, or death.

IMPORTANT: On multi-leaf suspensions, closely inspect each component of the leaf spring assemblies, including the brackets, U-bolts, and related parts.

60-Inch Taper-Leaf Spring Component Check

No lubrication is required on the 60-inch taper-leaf spring front and rear suspension.

Inspect the rear shackle brackets for bushing wear or cracks.

Inspect the stabilizer bar, if present, for irregular bushing wear or cracks in the brackets. Check the rubber helper spring, if present, for cracks.

32–06 Suspension U-Bolt Torque Check

Check the U-bolt torque of both the front and rear axles where applicable.

NOTICE

Failure to retorque the U-bolt nuts could result in spring breakage and abnormal tire wear.

1. Park the vehicle on a flat surface, apply the parking brake, and chock the tires.
2. Check the U-bolt torque in a diagonal pattern. See **Fig. 6**. Set a click-type torque wrench to the highest torque value for the fastener being checked. See **Table 3** for U-bolt torque specifications. Turn the wrench in a clockwise motion (looking up) until the torque wrench clicks.
3. Remove the chocks.

U-Bolt Torque Values		
Description	**Size**	**Torque: lbf·ft (N·m)**
Spring Assembly U-Bolt High Nuts*	5/8–18	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 180 to 230 (244 to 312)
	3/4–16	Stage 1: Hand tighten Stage 2: 60 (81) Stage 3: 200 (271) Stage 4: 270 to 330 (366 to 447)

* Tighten in the sequence shown in **Fig. 6**.

Table 3, U-Bolt Torque Values

32–07 V-Ride Rear Suspension Inspection

Along with the specific V-Ride suspension instructions provided, all suspension components should be inspected for wear or damage, and replaced if needed. These components include:

- air spring
- air supply (pneumatic components)
- apex bracket

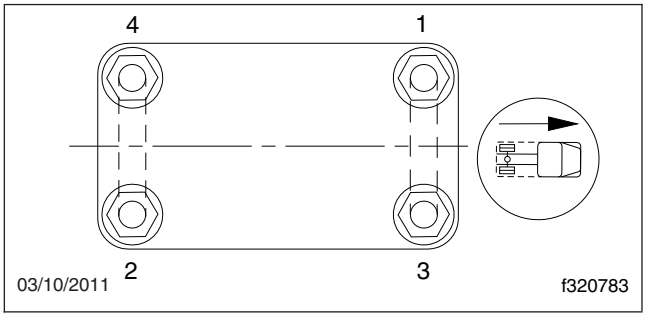


Fig. 6, Tightening Sequence for U-Bolt High Nuts

- fasteners
- frame hanger assembly
- QUICK-ALIGN connection
- shock absorbers
- torque rods
- U-beam assembly

⚠ WARNING

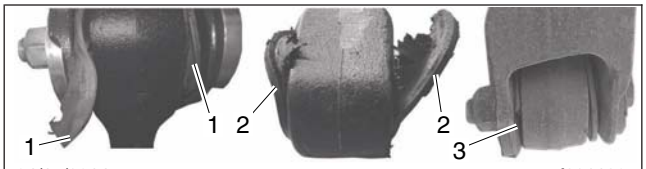
The pivot bushing and D-pin bushing are critical components of the V-Ride rear air suspension. If any components appear damaged or worn, the component must be replaced. Failure to replace worn or damaged components can result in the deformation of parts, loss of clamp force, bolt failure, loss of axle alignment, loss of vehicle control, property damage, or personal injury.

There are two types of pivot bushing inspections for the V-Ride suspension. The pivot bushing can be visually inspected by looking at the outer rubber flange(s) of the bushing. If the visual inspection warrants, a physical inspection can be conducted in which disassembly is required.

Pivot Bushing Visual Inspection

To perform a visual inspection of the pivot bushing, it is not necessary to disassemble the pivot bushing connection. If the pivot bushing rubber flange(s) are intact and there are no signs of metal-to-metal contact, the bushing does not require replacement.

- The U-beam assembly is designed with the pivot bushings centered in each U-beam end hub. If the pivot bushing is not centered in each hub, it is an indication that the pivot bushing could be worn and a pivot bushing physical inspection is required.
- If the pivot bushing shows signs of torn, separated, or disconnected rubber, as shown in **Fig. 7**, it could be the result of axle misalignment. If this condition is evident, a pivot bushing physical inspection is required.
- If the outer rubber flange(s) is missing, or there are shards of rubber visible, as shown in **Fig. 7**, it could be the result of axle misalignment. If this condition is evident, the pivot bushing must be replaced.



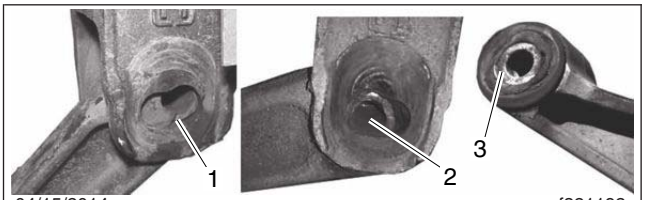
1. Torn Rubber
2. Disconnected Rubber Flange
3. Missing Rubber Flange

Fig. 7, Inspecting for Torn, Disconnected, or Missing Rubber Flange

Pivot Bushing Physical Inspection

1. Remove the U-beam assembly. For instructions, see **Section 32.05, Subject 140** in the *Recreational Vehicle Chassis Workshop Manual*.
2. After removal, inspect the pivot bushing connections and inner metal areas.
3. No replacement is needed if the pivot bushing exhibits a tight joint. See **Fig. 8**. An imprinted two-line wear pattern on the bushing inner metal indicates the pivot bushing is securely clamped in the frame hanger.
4. Inspect the pivot bushing. See **Fig. 9**. Any of the following items could be the result of axle misalignment or loose fasteners and require replacement of the pivot bushing:
   - an elongated or damaged bore
   - distorted, separated, or torn rubber
   - signs of rust
5. Inspect the inside of the frame hanger legs and the QUICK-ALIGN collars. If any of the following

Fig. 8, Good Joint with an Imprinted Two-Line Wear Pattern



NOTE: All of these examples exhibit a loose joint.

1. Elongated/Damaged Bore
2. Distorted Rubber
3. Rust

Fig. 9, Inspecting for Indications of a Loose Joint

are present, the pivot bushing and one or more of the mating components may require replacement:

- Evidence of wear marks on the inside of the frame hanger legs indicating metal-to-metal contact or movement.
- The snout of the QUICK-ALIGN concentric or eccentric collar is elongated or damaged.

6. Check the suspension alignment and adjust if necessary. For instructions, see **Section 32.05** in the *Recreational Vehicle Chassis Workshop Manual*.

D-Pin Bushing Visual Inspection

It is not necessary to disassemble the D-pin connection to perform a visual inspection of the D-pin bushing. The D-pin bushing is designed with a layer of rubber in the bushing. It is acceptable to see a bead of rubber protruding from the bushing. See **Fig. 10**.

1. Bead of Rubber

Fig. 10, Acceptable D-Pin

D-pin bushing replacement is required when metal-to-metal contact wear marks on the D-pin outer metal are evident, or the D-pin outer metal is distorted. See **Fig. 11**.

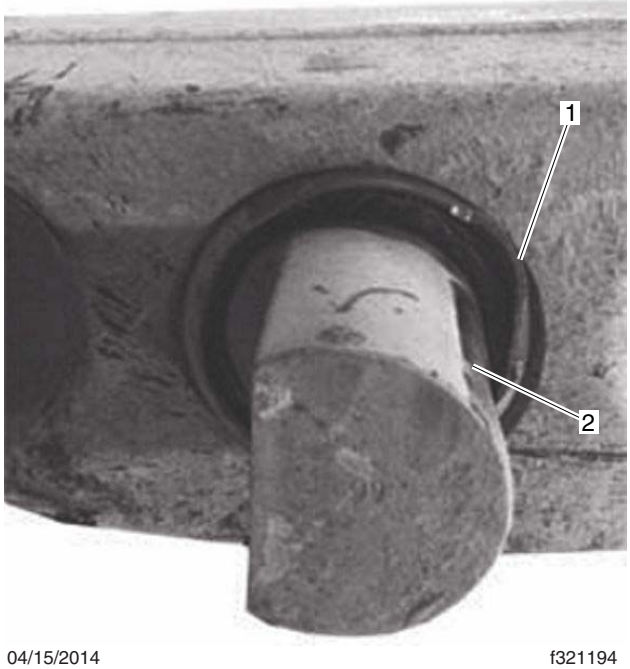
V-Rod Assembly Inspection

⚠ WARNING

The V-Ride rear air suspension incorporates V-torque rods for vehicle stability. If these components are disconnected or are non-functional, the vehicle should not be operated. Failure to do so can result in adverse vehicle handling and possible tire contact with the frame. Operating a vehicle with non-functional V-torque rods can result in the loss of vehicle control, severe personal injury, and component damage.

NOTE: Grade 8 bolts and Grade C locknuts are recommended for all torque rod attachments.

1. Visually inspect the torque rod bushing for metal-to-metal contact. Inspect for bent, cracked, or broken torque rods, and for end hubs with an elongated oval shape. Any of these conditions require component replacement.
2. Inspect the torque rods for looseness. With the vehicle shut down, a lever check can be per-



1. Distorted Outer Metal
2. Evidence of Metal-to-Metal Contact

Fig. 11, Unacceptable D-Pin

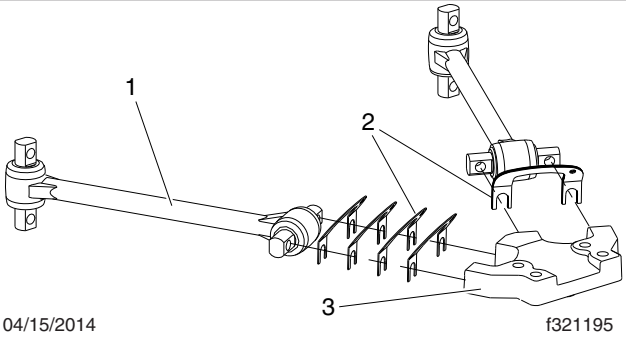
formed with a long pry bar placed under each rod end and pressure applied.

NOTE: Torque rod length is determined by the vehicle manufacturer to center the axles under the frame.

If the lateral alignment of the axles is incorrect, it may be necessary to shim the torque rod end that attaches to the V-rod bracket. See **Fig. 12**. For lateral alignment instructions, see **Section 32.05, Subject 180** in the *Recreational Vehicle Chassis Workshop Manual*.

3. Inspect the V-rod bracket for cracks, movement, or damage and replace the V-rod bracket if needed.

   The torque rod may be renewed by pressing out the worn bushings and replacing them. For instructions, see **Section 32.05, Subjects 120 and 130** in the *Recreational Vehicle Chassis Workshop Manual*.



1. Torque Rod Assembly
2. Torque Rod Shims
3. V-Rod Bracket

Fig. 12, V-Rod Assembly

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
All-Axle Alignment Checking	33–03
Knuckle Pin Lubricating	33–01
Oil-Filled Hubs Oil Changing	33–06
Oil-Filled Hubs Oil Level Checking	33–05
Safety Precautions	
Tie-Rod End Lubricating and Inspecting	33–02
Wheel End Inspection	33–04

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

33–01 Knuckle Pin Lubricating

NOTICE

Use regulated pressure when lubricating the knuckle assemblies, otherwise damage could result to the knuckle caps.

Detroit™ Axles

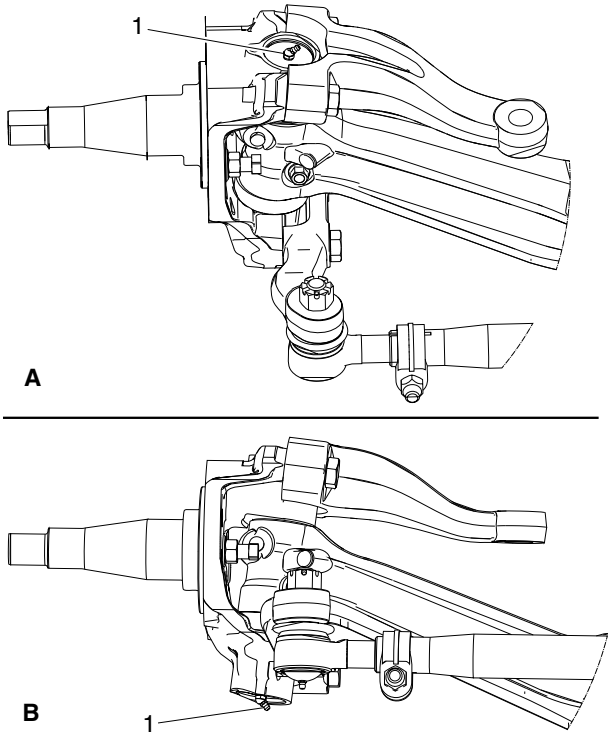
On the front axle, grease fittings are on the top and bottom caps of each knuckle.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires. When lubricating upper and lower knuckle assemblies, do not raise the front axle.
2. Wipe the grease fittings clean.
3. Apply multipurpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease), until new grease is seen at the junctions of the axle beam and knuckles. For locations of grease fittings, see **Fig. 1**; for grease exit points, see **Fig. 2**.

Meritor Axles

Hold a high-pressure grease gun on each fitting until fresh grease appears. See **Fig. 3**. This will ensure that all of the old contaminated grease has been forced out.

When lubricating Meritor axle knuckle pin bushings at the initial maintenance (IM) interval, first wipe the lube fittings clean. Then, slowly feed multipurpose chassis grease (NLGI grade 1 or 2) into each bushing area while turning the wheels from extreme right



A Upper View, LH Side B Lower View, LH Side
1. Grease Fitting

Fig. 1, Grease Fittings, Detroit Axles

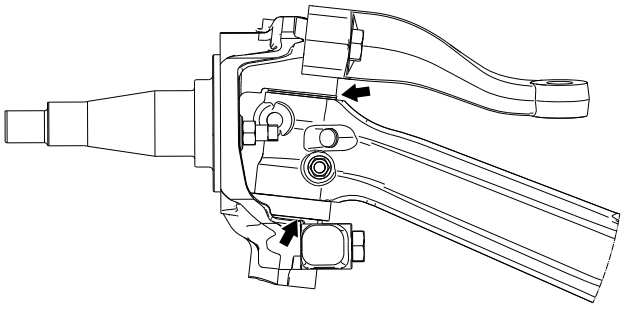
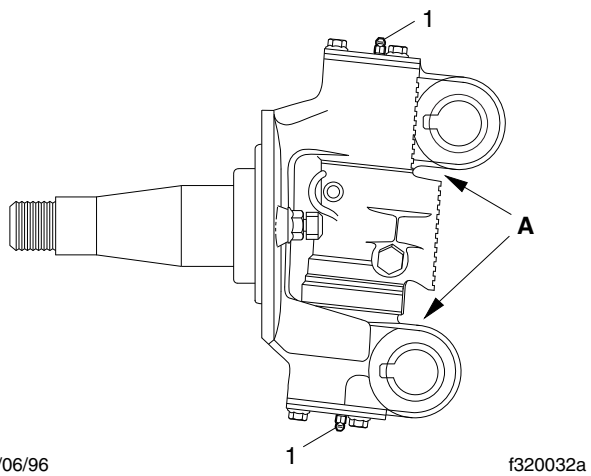


Fig. 2, Kingpin Grease Exit Points, Detroit Axles

to left, and back again (lock-to-lock). This will eliminate small air pockets and improve grease distribution.

NOTE: The grease seal will accept the grease pressure without damaging the seal, and is de-



Pump lubricant into each grease fitting until fresh grease comes out at A.

1. Grease Fitting

Fig. 3, Meritor Axle Grease Fittings

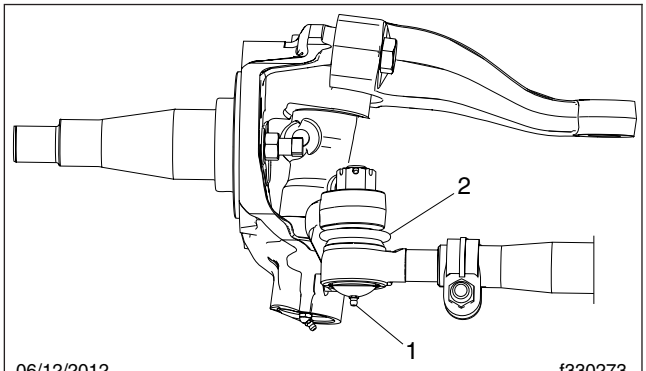
signed to have grease pumped out through it during lubrication. Even if grease leaks out around the top or bottom plate, continue pumping until new grease is seen at the seal on the bushing opposite the grease fitting.

When lubricating knuckle pin bushings after the IM maintenance interval, first wipe the lube fittings clean. Then apply multipurpose chassis grease until new grease is seen at the grease seal on the bushing opposite the fittings.

33–02 Tie-Rod End Lubricating and Inspecting

IMPORTANT: DOT roadside tie-rod assembly replacement criteria specifies that if tie-rod end-play is 1/8 inch (3 mm) or greater, measured on the road, the vehicle must be taken out of service immediately. If less than 1/8 inch (3 mm), the vehicle does not have to be taken out of service but a major out-of-service inspection and maintenance must be scheduled as soon as possible.

1. For any Detroit or Meritor axle that requires lubrication of the tie-rod ends, wipe the grease fittings clean, then pump multipurpose chassis grease, NLGI Grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI Grade 2 (8% 12-hydroxy lithium stearate grease), into the tie-rod ends until all used grease is forced out and fresh grease is seen at the ball stud neck. See **Fig. 4**.



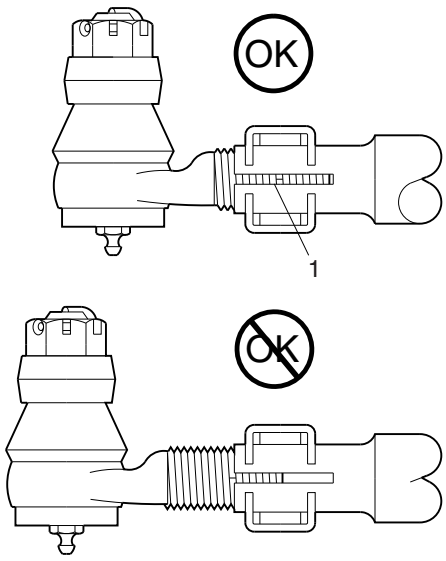
NOTE: No grease should emit from the tie-rod boot. If grease emits from the tie-rod boot, the boot is damaged.

1. Grease Fitting 2. Boot

Fig. 4, Grease Fitting and Boot (Detroit axle shown)

NOTE: Inspect the tie-rod end boots for cracks, wear, or damage. If a boot is cracked, worn, or damaged, replace the tie-rod assembly.

2. Inspect the tie-rod ends, as follows.
   - 2.1 Shake the cross-tube. Movement or looseness between the tapered shaft of the ball and the cross-tube socket members means that the tie-rod end assembly must be replaced.
   - 2.2 The threaded portion of the tie-rod end assembly must be inserted all the way into the cross-tube split for adequate clamping. See **Fig. 5**. Replace the parts if this cannot be done. For instructions, see the axle manufacturer's service manual.
   - 2.3 Check the tie-rod end nut and clamp nut torques. For Meritor axles, tighten the tie-rod end nut 100 lbf·ft (136 N·m), and tighten the clamp nut 40 to 55 lbf·ft (54 to 75 N·m). For Detroit axles, see **Table 1** for tie-rod end nut torque specifications and **Table 2** for tie-rod end clamp nut torque specifications.



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IMPORTANT: The tie-rod end threads must be visible throughout the entire length of the split.

NOTE: Pinch bolt not shown to provide clarity.

1. Cross-Tube Split

Fig. 5, Tie-Rod End Adjustment

Detroit Axle Tie-Rod End Nut	
Thread	**Torque: lbf·ft (N·m)**
5/8–16	60 to 115 (81 to 156)
5/8–18	60 to 115 (81 to 156)
3/4–16	90 to 170 (122 to 230)
7/8–14	160 to 300 (217 to 407)

Table 1, Detroit Axle Tie-Rod End Nut

Detroit Axle Tie-Rod End Clamp Nut	
Thread	**Torque: lbf·ft (N·m)**
1/2–13	35 to 45 (47 to 61)
5/8–11	40 to 60 (54 to 81)
5/8–18	50 to 64 (73 to 87)
3/4–10	155 to 175 (210 to 237)

Table 2, Detroit Axle Tie-Rod End Clamp Nut

33–03 All-Axle Alignment Checking

NOTE: The final stage manufacturer is responsible for setting the vehicle ride height with air suspension and some vehicle alignments. On full-railed chassis, this includes the final toe-in setting on the front axle. For modular style chassis, both the front axle toe-in and rear axle thrust angle settings are included.

Drive Axle Alignment Checking

NOTE: The maximum tolerance from perpendicular for rear axle alignment should be ±0.25 degree.

Check the axle alignment, parallelism, and thrust angle measurements for the rear axle. Use the applicable procedure and specifications in **Group 35** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

Toe-In Inspection

For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history.

NOTE: Toe-in should be within 0 to 1/32 inch (0.8 mm).

1. Apply the parking brake, and chock the rear tires.
2. Raise the front of the vehicle until the tires clear the ground. Check that the safety stands will support the combined weight of the body, axle, and frame. Place safety stands under the axle.
3. Using spray paint or a piece of chalk, mark the entire center rib of each front tire.
4. Place a scribe or pointed instrument against the marked center rib of each tire, and turn the tires. Hold the scribe firmly in place so that a single straight line is scribed all the way around each front tire.

5. Place a turn-plate or turntable under both front tires. Remove the safety stands from underneath the axle, then lower the vehicle. Remove the lockpins from the gauges; make sure that the tires are pointing straight ahead.

NOTE: If turn-plates or turntables are not available, lower the vehicle. Remove the chocks from the rear tires and release the parking brake. Move the vehicle backward and then forward about six feet (two meters).

6. Place a trammel bar at the rear of the front tires; locate the trammel pointers at spindle height, and adjust the pointers to line up with the scribe lines on the center ribs of the front tires. See **Fig. 6**. Lock the pointers in place. Check that the scale is set to zero.

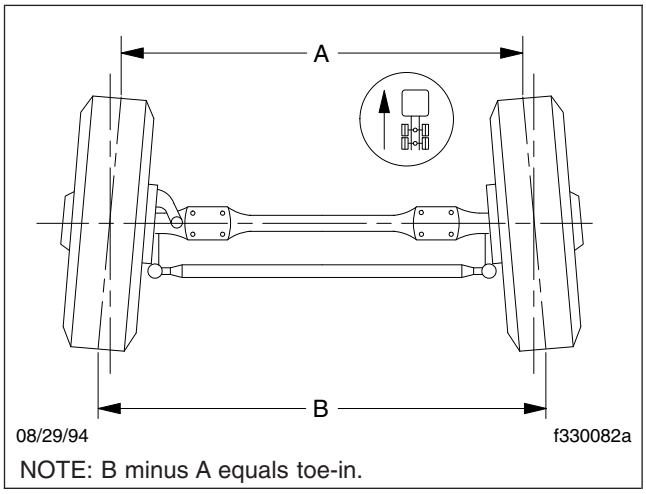


Fig. 6, Wheel Toe-In (overhead view)

7. Place the trammel bar at the front of the tires and adjust the scale end so that the pointers line up with the scribe lines. See **Fig. 7** and **Fig. 8**.
8. Read the toe-in from the scale, and compare it to the toe-in specification in **Group 33** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer. If corrections are needed, see **Group 33** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

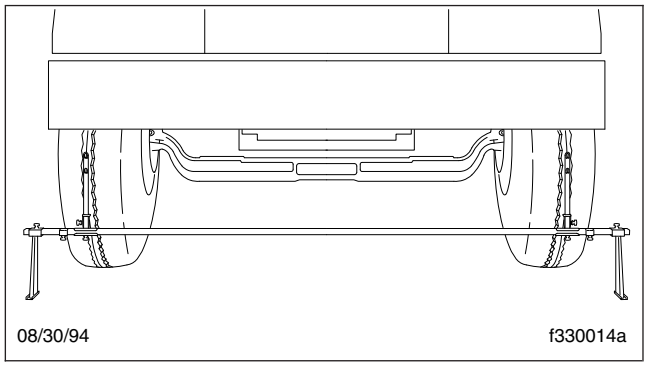


Fig. 7, Trammel Bar Positioning

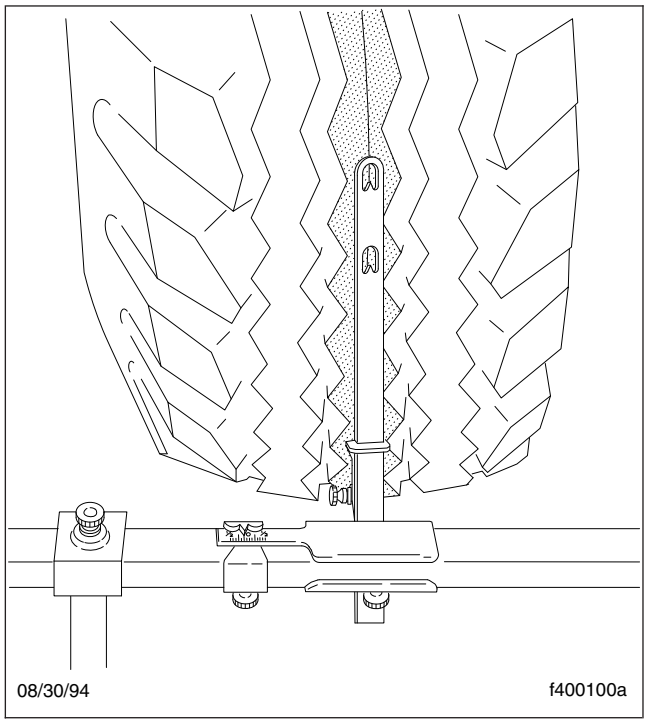


Fig. 8, Setting Trammel Bar Pointers

33–04 Wheel End Inspection

IMPORTANT: For ZF IFS axles, ZF recommends that all grease fittings be lubricated once a year, preferably before periods of inactivity. The wheel hub should be disassembled, inspected, and the wheel bearings repacked every 1,000,000 miles (1 609 000 km).

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.

⚠ WARNING

Never work around or under a vehicle that is supported only by a jack. Always support the vehicle with safety stands. Jacks can slip, causing the vehicle to fall, which could result in serious injury or death.

2. Raise the front of the vehicle and support it with safety stands.
3. Remove the front wheel and tire assemblies. For instructions, see **Group 40** of the *Recreational Vehicle Workshop Manual*.
4. Remove the brake drum. For more information, see **Group 33** of the *Recreational Vehicle Workshop Manual*.
5. Check for loose, damaged, or missing fasteners and hubcaps.
6. Check for lubricant around the hub cap and wheel. If lubricant is present, investigate the cause and take corrective action.
7. Check for lubricant around the hub, brake hardware, and brake shoes (if installed). If lubricant is present, check the oil seal and replace it as necessary. For instructions, see **Section 33.03** of the *Recreational Vehicle Workshop Manual*.
8. Inspect the lubricant for discoloration. Under normal conditions, the lubricant will darken; a white or milky appearance indicates water contamination. If the lubricant is discolored, service the wheel end. See the *Recreational Vehicle Workshop Manual* and manufacturer literature for procedures.

IMPORTANT: Do not mix different types of lubricants.

9. Inspect the lubricant for the presence of foreign matter. Use a magnet to detect any metallic materials present in the lubricant. If the lubricant is contaminated, service the hub. See the *Recreational Vehicle Workshop Manual* and manufacturer literature for procedures.
10. Rotate the hub and check for free, smooth, and quiet rotation. If rotation is hampered, service the hub immediately. See the *Recreational Vehicle Workshop Manual* and manufacturer literature for procedures.

⚠ WARNING

Correct wheel-bearing end play is crucial to the safe and sound operation of the vehicle. If the end play is not correct, the wheel bearings could fail and cause the loss of the wheel and hub assembly and result in an accident causing property damage, serious injury, or death. Use a dial indicator to measure the end play.

IMPORTANT: Do not measure the wheel bearing end play with the wheel mounted on the hub; you cannot accurately measure or adjust bearing end play with the wheel mounted on the hub. Also, ensure that the brakes are not applied so that that drum and hub can move freely.

11. Using a dial indicator, measure the end play as follows.

    11.1 Attach the magnetic base of a dial indicator to the end of the spindle, and place the measuring end of the indicator against the hub cap mounting flange. See **Fig. 9**.

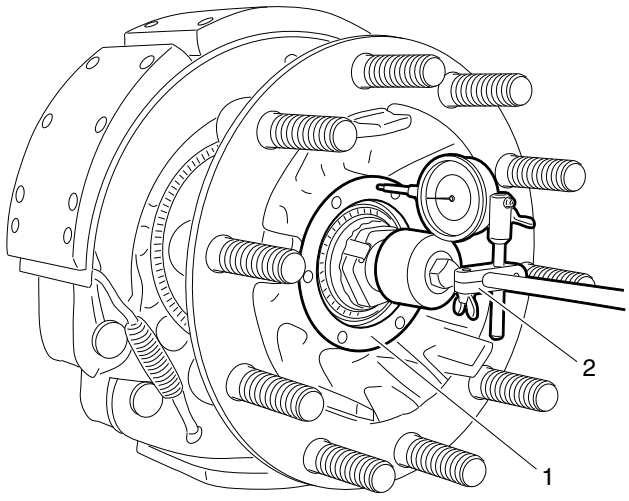
    IMPORTANT: Maintain continual pressure on the hub until you have taken both the inboard and outboard measurements. If you release the hub, an accurate measurement is not possible.

    11.2 To seat the bearings, grip the hub at the three o'clock and nine o'clock positions, and push inward while oscillating it approximately 45 degrees. Maintain pressure on the hub, note the inboard measurement, and then pull the hub outward while oscillating it as before. Maintain pressure on the hub, and note the outboard measurement. See **Fig. 10**.

    The end play is the difference between the two measurements. The end play limit for PreSet hubs is 0.006 inch (0.15 mm); for non-PreSet hubs the acceptable range is 0.001 to 0.005 inch (0.03 to 0.13 mm) inclusive.

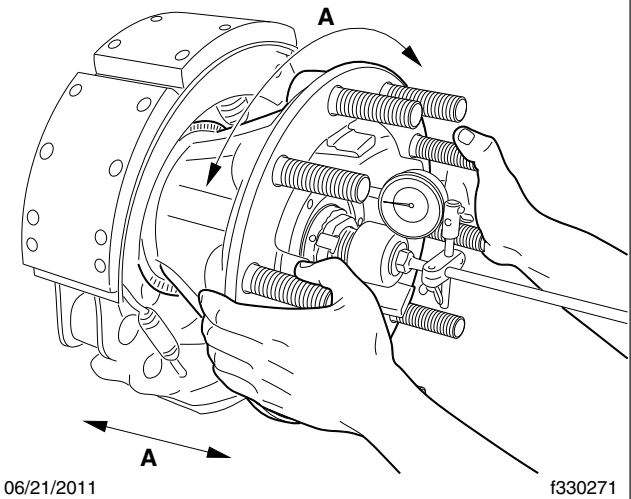
    If the end play does not exceed the limit and no other problems were found in the previous steps, no additional service is

necessary. If the end play exceeds the limit, service the hub. See the *Recreational Vehicle Workshop Manual* and manufacturer literature for procedures.



1. Hub Cap Mounting Flange
2. Dial Indicator (with magnetic base)

Fig. 9, Dial Indicator Setup



A. Pull and push the hub while oscillating it.

Fig. 10, Measuring End Play

33–05 Oil-Filled Hubs Oil Level Checking

⚠ WARNING

Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, rotate the front wheels and allow the oil in the hubs to settle.
2. Chock the tires.

IMPORTANT: The oil level should be at, or no more than 1/4 inch (6 mm) above the level indicators on the hub caps.

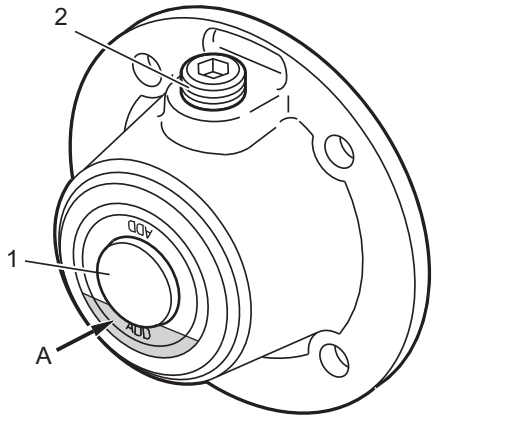
3. If necessary, remove the filler caps (in the ends of the hub caps) and add enough oil (80W–90 hypoid gear oil) to bring the oil to the proper level.
4. Rotate the wheels, allow the oil to settle, and check the levels again.
5. Install the filler caps securely.
6. Remove the chocks from the tires.

33–06 Oil-Filled Hubs Oil Changing

⚠ WARNING

Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, rotate the front wheels so that the front hub drain plugs are positioned downward.
2. Chock the tires.
3. Place suitable containers under the hubs, remove the filler plugs (in the ends of the hub caps) and the drain plugs, and allow the hubs to drain completely. See **Fig. 11**.



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A. Hub Cavity Full
1. Fill Plug/Magnetic Drain
2. Drain Plug

Fig. 11, Oil-Filled Hub Cap

4. Install the drain plugs and tighten 25 lbf·in (282 N·cm).
5. Add approximately 1 to 1-1/2 pints (0.5 to 0.7 L) of oil (80W–90 hypoid gear oil) to each hub.
6. Rotate the wheels, allow the oil to settle, and check the levels.

IMPORTANT: Fill the hubs to the level indicators on the hub caps, or to no more than 1/4 inch (6 mm) above the indicators. See **Fig. 11**.

7. Install the filler plugs securely.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Axle Breather Checking	35–03
Axle Lubricant Changing and Magnetic Plug Cleaning	35–02
Axle Lubricant Level Checking	35–01
Oil-Filled Hubs Oil Changing, Tag Axle	35–05
Oil-Filled Hubs Oil Level Checking, Tag Axle	35–04
Safety Precautions	

Safety Precautions

DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

35–01 Axle Lubricant Level Checking

NOTICE

Failure to keep the rear axle filled to the proper level with the recommended lubricant can result in rear axle damage.

NOTE: If the vehicle is exposed to water deep enough to cover the hubs, disassemble and inspect them for water damage and/or contamination. See **Group 35** of the *Recreational Vehicle Chassis Workshop Manual* for instructions, or take the vehicle to an authorized Freightliner dealer.

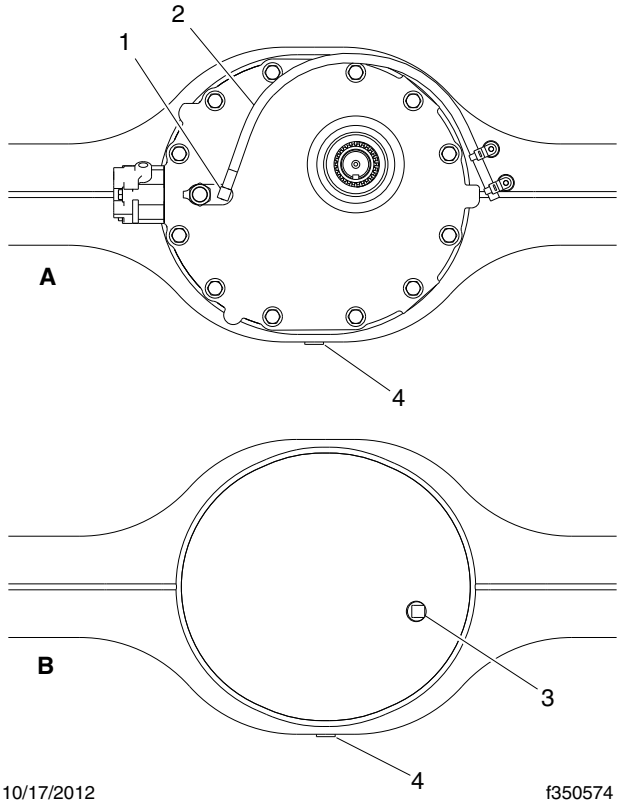
1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. If the vehicle has just been driven, allow a few minutes for the lubricant to settle.
3. Clean the fill plug and the area surrounding the fill plug on the side of the axle carrier. Remove the plug. Check lubricant level when the axle is cold, or near room temperature. See **Fig. 1** and **Fig. 2**.

NOTE: Some Meritor axles have a small tapped and plugged hole located below the housing oil fill hole. This smaller hole is for the lubricant temperature sensor only and must not be used as a fill or level hole.

4. Check that the lubricant is level with the bottom of the fill hole. See **Fig. 3**. If low, check for oil leaks, and correct as needed. Add oil to the level of the fill plug, using the lubricant in **Table 1** for Detroit axles or **Table 2** for Meritor axles.

IMPORTANT: A lubricant level close enough to be seen or touched is not sufficient. It must be level with the bottom of the fill hole.

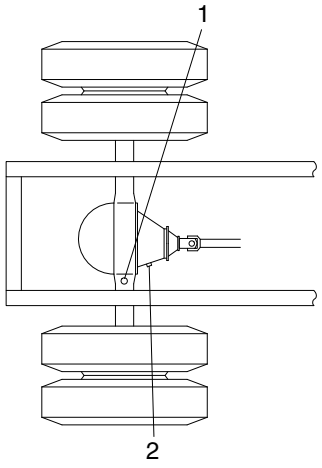
5. Install the oil fill plug and tighten it 30 lbf·ft (41 N·m) for Detroit axles or 35 lbf·ft (47 N·m) for Meritor axles.



NOTE: Typical engine-rear configuration shown; engine-front configuration is similar.

A. Rear View
B. Front View
1. Axle Housing Breather
2. Breather Hose
3. Oil Fill Plug
4. Oil Drain Plug

Fig. 1, Component Locations, Detroit Axles



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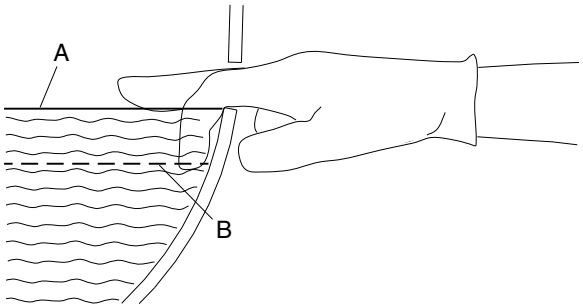
1. Axle Housing Breather
2. Oil Fill Plug

Fig. 2, Component Locations, Meritor Axles



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A. Correct (lube level at bottom of fill hole)
B. Incorrect (lube level below fill hole)

Fig. 3, Checking Axle Lubricant Level

Detroit Drive Axle Lubricants*		
IMPORTANT: Lubricant used in Detroit rear axles must meet Mercedes-Benz specification 235.20 (mineral) or 235.8 (synthetic). Mobil Delvac™ Gear Oil A 80W-90 and Mobilube™ HD-A Plus 80W-90 meet specification 235.20. Mobil Delvac 1 Gear Oil 75W-90 and Mobilube 1 SHC 75W-90 meet specification 235.8. For more product information, see http://bevo.mercedes-benz.com.		
Type	**Ambient Temperature**	**SAE Viscosity Grade**
Mineral Oil	–15°F (–26.1°C) and up†	80W–90

Detroit Drive Axle Lubricants*		
IMPORTANT: Lubricant used in Detroit rear axles must meet Mercedes-Benz specification 235.20 (mineral) or 235.8 (synthetic). Mobil Delvac™ Gear Oil A 80W-90 and Mobilube™ HD-A Plus 80W-90 meet specification 235.20. Mobil Delvac 1 Gear Oil 75W-90 and Mobilube 1 SHC 75W-90 meet specification 235.8. For more product information, see http://bevo.mercedes-benz.com.		
Type	**Ambient Temperature**	**SAE Viscosity Grade**
Synthetic Oil	–40°F (–40°C) and up†	75W–90

* Detroit rear axles do not require the use of friction modifiers.

† There is no upper limit on the ambient temperature, but axle sump temperature must never exceed 250°F (121°C).

Table 1, Detroit Drive Axle Lubricants

Drive Axle Recommended Lubricant, Meritor Axles		
Recommended Lubricant Type	**Ambient Temperature**	**Lubricant SAE Viscosity Grade**
Hypoid Gear Oil API Service Classification GL–5	10°F (–12.2°C) and up*	85W–140
	–15°F (–26.1°C) and up*	80W–90
	–40°F (–40°C) and up*	75W–90
	–40°F (–40°C) to 35°F (2°C)	75W
	–40°F (–40°C) and up*	75W–140
Synthetic Gear Oil	–40°F (–40°C) and up*	75W–90
	–40°F (–40°C) and up*	75W–140

* There is no upper limit on the ambient temperature, but axle sump temperature must never exceed 250°F (121°C).

Table 2, Drive Axle Recommended Lubricant, Meritor Axles

35–02 Axle Lubricant Changing and Magnetic Plug Cleaning

A regular schedule for changing the axle lubricant in a particular vehicle and operation can be accurately determined by analyzing oil samples taken from the axle at specified intervals or mileages. Lubricant suppliers frequently make their laboratory facilities available for determining the useful life of their product under actual service conditions. The final schedule that is recommended may, for economic reasons, be

related to lubricant changes that are governed by climatic conditions and magnetic plug maintenance. Change lubricant type and viscosity as climatic temperatures demand, regardless of vehicle mileage or established change schedule.

The normal operating temperature of compounded lubricants during the summer season is about 160 to 220°F (71 to 104°C). The chemicals and additives that give these lubricants increased load carrying capacity oxidize faster at temperatures above 220°F (104°C), contributing to more rapid lubricant deterioration. For this reason, lubricants of this type that operate continuously at high temperatures must be changed more frequently.

NOTICE

Failure to change the axle lubricant at more frequent intervals, when adverse operating conditions require, could result in axle damage.

Axle Draining

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Clean the fill plug and the area around it. Remove the plug from the oil fill hole. See **Fig. 1**.

⚠ CAUTION

Be careful when draining the axle oil. It may be very hot, and could cause personal injury if it contacts the skin.

3. Remove the plug at the bottom of the housing and drain the lubricant while the unit is warm. Allow enough time for all the old lubricant to drain completely.
4. Clean the drain plug. For magnetic drain plugs, a piece of key stock or any other convenient steel slug may be used to short the two magnetic poles and divert the magnetic field.

NOTE: Meritor recommends using magnetic plugs with elements having a minimum pickup capacity of two pounds (one kilogram) of low-carbon steel in plate or bar form. Magnets will rapidly lose effectiveness as collected material bridges the gap between the two poles. Clean or change the plugs before this occurs. It may be necessary to clean or change the plugs one or more times between lubrication change intervals.

5. After cleaning the drain plug, install and tighten the plug 30 lbf·ft (41 N·m) for Detroit axles or 35 lbf·ft (47 N·m) for Meritor axles.

Axle Filling

1. With the vehicle on a level surface, fill the axle housings to the bottom of the oil fill hole (in the carrier or housing) with recommended lubricant; see **Table 2**. Refer to **Table 3** for Detroit drive axle lubricant capacities or **Table 4** for Meritor drive axle lubricant capacities.

NOTE: Some Meritor axles have a small tapped and plugged hole located below the housing oil fill hole. This smaller hole is for the lubricant temperature sensor only and must not be used as a fill or level hole.

2. Install the fill hole plug and tighten it 30 lbf·ft (41 N·m) for Detroit axles or 35 lbf·ft (47 N·m) for Meritor axles.
3. After filling the carrier and housing assembly with lubricant, drive the vehicle unloaded for one or two miles (two or three kilometers) at speeds not to exceed 25 mph (40 km/h) to thoroughly circulate the lubricant throughout the assembly.

Detroit Drive Axle Lubricant Capacities	
Axle Model*	**Capacity†: pints (L)**
ARS–13.0–2	15 (7)
ARS–15.0–2	15 (7)
ARS–17.5–2	15 (7)
ARS–19.0–2	15 (7)
ARS–20.0–2	15 (7)
ARS–21.0–2	15 (7)
ARS–21.0–4	23 (11)
ARS–23.0–4	23 (11)

* Model code may have a "D" in the prefix (for example, DA–RS–13.0–2).

† Quantities listed are approximate and include 1 pint (0.5 liter) for each wheel end and with the drive pinion at 3 degrees.

Table 3, Detroit Drive Axle Lubricant Capacities

Meritor Drive Axle Lubricant Capacities	
Axle Model	**Capacity*: pints (L)**
MS–10–113D	14 (6.6)
MS–12–113D	15 (7.1)
RS–13–120	18.4 (8.7)
RS–15–120	14.3 (6.8)
RS–17–145	33.6 (15.9)
RS–17–144	32.3 (15.3)
RS–19–144	32.3 (15.3)
RS–19–145	33.2 (15.7)
RS–21–145	32.3 (15.3)
RS–21–160	39.5 (18.7)
RS–21–230	38.9 (18.4)
RS–23–160	39.5 (18.7)
RS–23–161	39.5 (18.7)
RS–23–186	47.3 (22.4)
RS–23–240	37.4 (17.7)
RS–26–185	38.0 (18.0)
RS–30–185	38.0 (18.0)

* Quantities listed are approximate and include 1 pint (0.5 liter) for each wheel end and with the drive pinion at 3 degrees.

Table 4, Meritor Drive Axle Lubricant Capacities

35–03 Axle Breather Checking

NOTE: Detroit axles have a breather hose wrapped around the housing breather. The breather hose length should not be lower than approximately 1 inch below the axle housing weld seam.

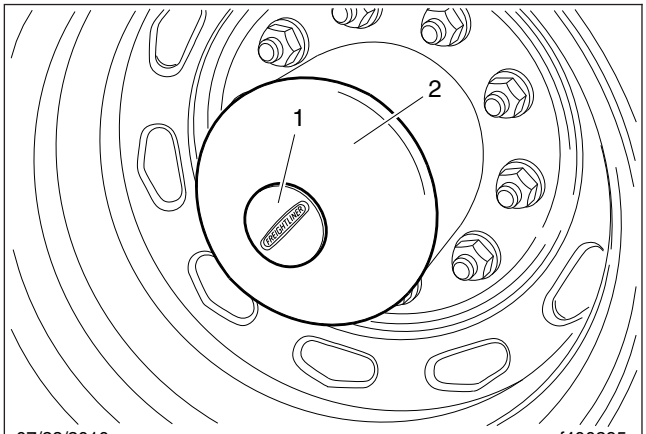
The axle housing breather must remain clean. See **Fig. 1** and **Fig. 2**. When the axle lubricant level is checked, check that the axle breather is open. Check more often under poor operating conditions. If the breather is plugged, clean it or replace it as needed.

35–04 Oil-Filled Hubs Oil Level Checking, Tag Axle

⚠ WARNING

Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, remove the hub cap (also referred to as a beauty ring). See **Fig. 4**.



1. Cap Head
2. Hub Cap (Beauty Ring)

Fig. 4, Rear Axle Hub Cap Assembly

2. Rotate the rear wheels and allow the oil in the hubs to settle.
3. Chock the tires.

IMPORTANT: The oil level should be at, or no more than 1/4 inch (6 mm) above the level indicators on the hub caps.

4. If necessary, remove the filler caps (in the ends of the hub caps) and add enough oil (80W–90 hypoid gear oil) to bring the oil to the proper level.
5. Rotate the wheels, allow the oil to settle, and check the levels again.
6. Install the filler caps securely.

NOTICE

Do not overtighten the cap head. Too much force will strip the screw.

7. Install the hub cap and tighten the cap head just until snug.

35–05 Oil-Filled Hubs Oil Changing, Tag Axle

WARNING

Be careful not to overfill the hubs. Overfilling may cause oil to be forced out of the hubs and to contaminate the brake linings and other brake components. This could result in loss of vehicle control and lead to personal injury and property damage.

1. With the vehicle on a level surface, remove the hub cap (also referred to as a beauty ring).
2. Rotate the rear wheels so that the rear hub drain plugs are positioned downward.
3. Chock the tires.
4. Place suitable containers under the hubs, remove the filler plugs (in the ends of the hub caps) and the drain plugs, and allow the hubs to drain completely. See **Fig. 5**.
5. Install the drain plugs and tighten securely.
6. Add approximately 1 to 1-1/2 pints (0.5 to 0.7 L) of oil (80W–90 hypoid gear oil) to each hub.

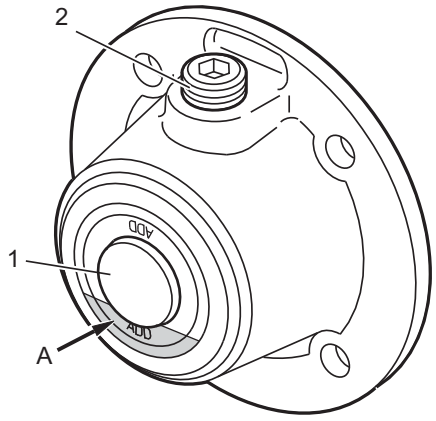
IMPORTANT: Fill the hubs to the level indicators on the hub caps, or to no more than 1/4 inch (6 mm) above the indicators. See **Fig. 5**.

7. Rotate the wheels, allow the oil to settle, and check the levels.
8. Install the filler plugs securely.

NOTICE

Do not overtighten the cap head. Too much force will strip the screw.

9. Install the hub cap and tighten the cap head just until snug.



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A. Hub Cavity Full
1. Fill Plug/Magnetic Drain
2. Drain Plug

Fig. 5, Oil-Filled Hub Cap

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Wheel Cleaning and Polishing	40–02
Wheel Nut Checking	40–01

40–01 Wheel Nut Checking

IMPORTANT: In addition to the maintenance interval in this manual, check the wheel nut torque the first 50 to 100 miles (80 to 160 km) of operation after a wheel has been removed and installed.

NOTE: On each wheel stud, the end that faces away from the vehicle is stamped with an "L" or an "R," depending on which side of the vehicle the stud is installed. Studs stamped with an "L" are left-hand threaded and are installed on the driver's side of the vehicle. Studs stamped with an "R" are right-hand threaded and are installed on the passenger's side of the vehicle.

When checking wheel nuts on a dual disc assembly, remove one outer nut at a time, tighten the inner nut, then reinstall the outer nut. Repeat this procedure for all of the inner wheel nuts in the sequence shown in **Fig. 1**, **Fig. 2**, or **Fig. 3**. Then, tighten all of the outer wheel nuts in the same sequence.

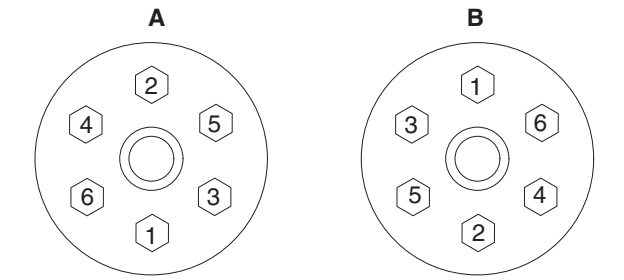
⚠ CAUTION

Too little wheel nut torque can cause wheel shimmy, resulting in wheel damage, stud breakage, and extreme tire tread wear. Too much wheel nut torque can break studs, damage threads, and crack discs in the stud hole area.

Tighten the wheel nuts.

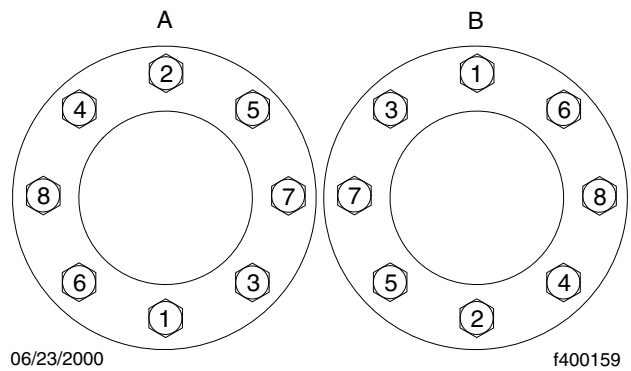
- On 6-stud, stud-pilot hubs, tighten the wheel nuts 450 to 500 lbf·ft (610 to 678 N·m). See **Fig. 1** for the tightening sequence.
- On 8-stud or 10-stud, hub-pilot hubs with 20-mm studs, tighten the wheel nuts 280 to 310 lbf·ft (380 to 420 N·m). See **Fig. 2** or **Fig. 3** for the tightening sequence.
- On 8-stud or 10-stud, hub-pilot hubs with 22-mm studs, tighten the wheel nuts 450 to 500 lbf·ft (610 to 678 N·m). See **Fig. 2** or **Fig. 3** for the tightening sequence.

NOTE: Wheel nuts for 20-mm stud hubs require a 1- 3/16-inch (30-mm) socket. Wheel nuts for 22-mm stud hubs require a 1-5/16-inch (33-mm) socket.



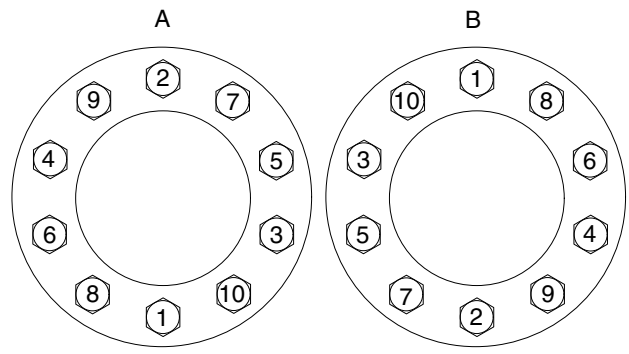
A. Front and Inner Rear Dual
B. Outer Rear Dual

Fig. 1, Wheel Nut Tightening Sequence (6-stud hubs)



A. Front and Inner Rear Dual
B. Outer Rear Dual

Fig. 2, Wheel Nut Tightening Sequence (8-stud hubs)



A. Front and Inner Rear Dual
B. Outer Rear Dual

Fig. 3, Wheel Nut Tightening Sequence (10-stud hubs)

40–02 Wheel Cleaning and Polishing

Accuride® Machined and Polished Aluminum Wheels

IMPORTANT: Do not scrub the wheels before rinsing off particles with high-pressure water. Rubbing debris against the surface of the wheel can result in scratches. Synthetic cleaning pads and wire brushes should not be used to clean the wheels.

Do not use strong detergents, alkaline, or acidic cleaners to clean Accuride aluminum wheels. These solutions can etch the surface of the aluminum and leave dull areas. Do not use polishes or wax on Accuride ACCU-SHIELD aluminum wheels.

1. Rinse the wheel with high-pressure water to remove debris.
2. Use a 100% cotton cloth dipped in a mild soap solution to help remove built up dirt and grease. Dish soap or automotive car wash soap are recommended.
3. Rinse the remaining soap residue from the wheel. Do not allow soap residue to dry on the surface of the wheel.
4. Dry the wheel thoroughly with a 100% cotton cloth.
5. Commercial bug/tar/grime cleaners may be used to remove stuck-on particles from the wheel. It is recommended that the cleaner be tested in an inconspicuous area for discoloration before treating the wheel.
6. Do not use strong solvents to remove grease or grime from the surface of the wheel. Damage to the wheel surface finish might occur.
7. Do not use polishes or wax on ACCU-SHIELD aluminum wheels. The finish will maintain the bright and shiny surface for years to come without the need for special polishes.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Driveline Inspection and Lubrication	41–01
Safety Precautions	

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

41–01 Driveline Inspection and Lubrication

Inspection

Before lubricating the driveline U-joints and slip-joints, make the following checks.

1. Check that the yoke-strap capscrews are tightened 50 to 60 lbf·ft (68 to 81 N·m).

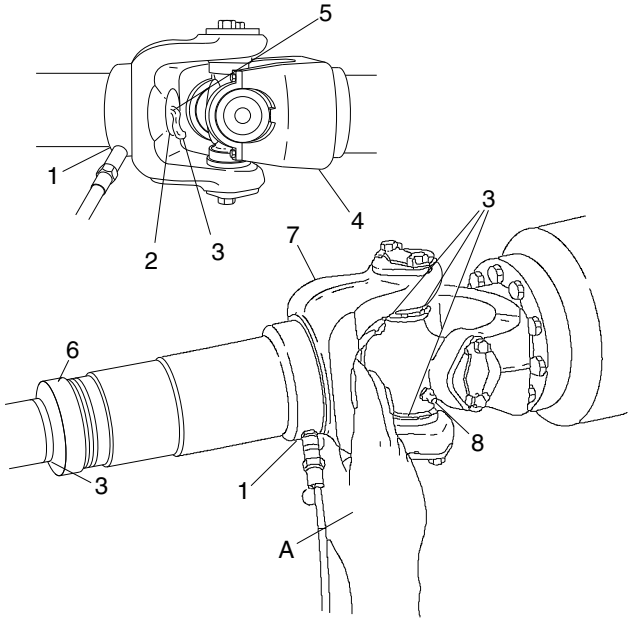
NOTICE

Do not overtighten the yoke-strap capscrews, due to the extreme load occurring at high-speed rotation. A loose or broken capscrew at any point in the driveline weakens the driveline connection, which could eventually result in serious vehicle damage.

2. Check the slip-joints for spline wear by trying to bend the sleeve-yoke and splined shaft back and forth. If looseness is greater than 0.007 inch (0.18 mm), replace both the sleeve-yoke and the splined shaft.
3. Check the driveshaft for missing balance weights, and for debris buildup. Remove any buildup. If any balance weights are missing, remove the driveshaft and have it balanced. For instructions, see **Group 41** of the vehicle *Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
4. Check that the yoke plug is not loose or missing. Replace the yoke plug if needed. If the yoke plug is missing, the splined shaft may be hitting the yoke plug and knocking it out; check the driveshaft for proper length.

U-Joint Lubrication

1. Wipe all old grease and dirt from each U-joint grease fitting.
2. Use a hand-type grease gun, or a high-pressure gun with a low-pressure adaptor, to lubricate the U-joints. See **Fig. 1**.



A. After grease appears, cover the pressure-relief hole while continuing to lubricate.

1. Slip-Joint Grease Fitting (with grease gun attached)
2. Yoke Plug
3. Grease
4. Half-Round Yoke
5. Yoke Plug Pressure-Relief-Hole
6. Slip-Joint Seal
7. Full-Round Yoke
8. U-Joint Grease Fitting

Fig. 1, Slip-Joint and U-Joint Lubricating

NOTE: If a low-pressure adaptor is not used with the high-pressure gun, the U-joints may not receive enough lubricant.

3. Using lithium 12-hydroxy stearate grease (NLGI grade 1 or 2, with EP additives), lubricate until new grease can be seen at all four U-joint seals.

NOTICE

Fresh lubricant must be seen escaping from *all four* of the bearing cup seals of each U-joint. If not, the U-joint may fail prematurely.

4. If the bearing will not take grease, replace the U-joint assembly. For instructions, see **Group 41** of the vehicle *Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
5. Check the old grease. If it appears rusty, gritty, or burned, replace the U-joint assembly. For instructions, see **Group 41** of the vehicle *Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
6. Wipe any excess grease from the seals and grease fittings.

Slip-Joint Spline Lubrication

1. Wipe all old grease and dirt from the slip-joint grease fitting.
2. Use a hand-type grease gun or a high-pressure gun with a low-pressure adaptor, to lubricate the slip-joint. Using lithium 12-hydroxy stearate grease (NLGI grade 1 or 2, with EP additives), lubricate until fresh grease appears at the pressure-relief hole in the yoke plug. Then cover the relief hole with your finger, as shown in **Fig. 1**, while continuing to lubricate until fresh grease appears at the slip-joint seal. This ensures complete lubrication of the splines.
3. Wipe any excess grease from the pressure-relief hole, slip-joint seal, and grease fitting.

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Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

42–01 Brake System Valves Inspecting

1. Clean the valves exterior and inspect them for corrosion and damage.
2. Inspect the air lines connected to the valves for signs of wear or damage. Replace the lines as needed.
3. Check the valves for leakage.
   - 3.1 Apply the service brakes and hold them on a full line pressure of at least 80 psi (552 kPa).
   - 3.2 Check the air line fittings for leaks; tighten or replace the fittings as needed.
   - 3.3 Coat the exhaust port and body of the valves with soapy water, and check for leakage. Leakage is excessive if it produces a 1-inch (25-mm) bubble within 5 seconds.

     If a brake valve does not function as described above, or if leakage is excessive, replace it with a new or remanufactured unit. Repeat the leakage checks before placing the vehicle in service.

42–02 Air Dryer Checking

IMPORTANT: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every 12 months:

1. Check for moisture in the air brake system by opening reservoir drain valves and checking for presence of water. If moisture is present, the desiccant cartridge may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:
   - An outside air source has been used to charge the system. This air did not pass through the drying bed.
   - Air usage is exceptionally high and not normal. This may be due to high air system leakage.
   - In areas where more than a 30-degree range of temperature occurs in one day, small amounts of water can temporarily accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal.

NOTE: A small amount of oil in the system is normal and should not be considered as a reason to replace the desiccant cartridge. Some oil at the dryer exhaust is normal.

2. Visually check for physical damage, such as chaffed or broken air and electrical lines and broken or missing parts.
3. Check the mounting bolts for tightness. See **Table 1** for torque values.

Torque Values		
Vendor	**Size**	**Torque: lbf·ft (N·m)**
Bendix	Grade 5, 3/8–16	28 (38)
	Grade 5, 5/8–11	135 (183)
Haldex	1/2–13	45 to 55 (61 to 75)

Table 1, Torque Values

4. Perform the operational and leakage tests listed below.

Operational and Leakage Tests

1. Check all lines and fittings leading to and from the air dryer for leakage and integrity. Repair any leaks found.
2. Build system pressure to governor cutout and note that the dryer purges with an audible escape of air. Watch the system pressure and note the pressure fall-off for a 10-minute period. If the pressure drop exceeds 1 psi/minute from either service reservoir, inspect the vehicle air systems for sources of leakage and repair them. Refer to troubleshooting information in Bendix or Haldex service literature.
3. Check for excessive leakage around the purge valve with the compressor in the loaded mode (compressing air). Apply a soap solution to the purge valve exhaust port and observe that leakage does not exceed a 1-inch (25-mm) bubble in 1 second. If the leakage exceeds the maximum specified, refer to troubleshooting information in the Bendix or Haldex service literature.
4. Build system pressure to governor cutout and note that the dryer purges with an audible escape of air. Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a dryer purge. If the system does not follow this pattern, refer to troubleshooting information in the Bendix or Haldex service literature.
5. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:

   5.1 Electric Power to the Dryer: With the ignition in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or testlight. Unplug the electrical connector at the air dryer and place the test leads on each of the connections of the female connector on the vehicle power lead. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

   5.2 Thermostat and Heater Assembly Operation: These tests are not possible except in cold weather operation. Turn off the ignition switch and cool the thermostat and heater assembly to below 40°F (4°C). Using an ohmmeter, check the resistance between the electrical pins in the air dryer connector half. The resistance should be 1.5 to 3.0 ohms for the 12-volt heater assembly and 6.0 to 9.0 ohms for the 24-volt heater assembly.

   NOTE: Some models of the AD–9 may have a resistance reading of 1.0 to 2.5 ohms.

   Warm the thermostat and heater assembly to approximately 90°F (32°C) and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the heater and thermostat assembly.

42–03 Air Dryer Desiccant and Coalescent Filter Replacing

NOTE: Desiccant change intervals may vary from vehicle to vehicle. Typical desiccant cartridge life is three years. However, if experience has shown that extended or shortened life has resulted on a particular installation, then the interval can be increased or decreased accordingly.

Bendix AD-9

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Completely drain all air reservoirs. Air pressure gauges should read 0 psi (0 kPa).
3. Loosen the desiccant cartridge with a strap wrench at the base of the cartridge. Spin off the cartridge and discard it.
4. Remove the O-ring from the threaded neck and discard it.
5. Remove the coalescent filter and discard it.

IMPORTANT: Lubricate the new O-rings prior to installation.

6. Install the new small O-ring in the groove on the bottom of the new coalescent filter.
7. Insert the coalescent filter with the O-ring end going into the air dryer opening first. The end of the filter with the "X" will then be facing out.
8. Install the other new O-ring over the threaded neck of the desiccant cartridge.
9. Screw on the desiccant cartridge until resistance is detected. Then, tighten the cartridge 1/4 to 3/4 of a turn by hand.
10. Before placing the vehicle in service, perform the test below.
    - 10.1 Start the engine and build air pressure to 120 psi (827 kPa).
    - 10.2 Listen for the purge valve to open and release air. A large volume of air will be expelled, followed by a slow flow of air lasting approximately 30 seconds.
    - 10.3 Shut down the engine.
    - 10.4 Perform the inspections in **Maintenance Operation 42–02**.

Bendix AD-IP

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Using a wrench or a socket, loosen the desiccant cartridge bolt. Then separate the desiccant cartridge from the end cover.
3. Pull the cartridge bolt out of the cover and remove the cartridge.

⚠ WARNING

Do not attempt to disassemble the desiccant cartridge assembly. Parts for the assembly are not available and the cartridge contains a 150 lb spring that cannot be mechanically caged. Disassembly could release the spring, resulting in personal injury.

4. Remove and discard both O-rings from the cartridge bolt.
5. Using a clean rag, wipe clean the inside of the end cover. Clean the cartridge bolt bore in the end cover, and the sealing surfaces for the large- and small-diameter desiccant cartridge sealing rings.
6. Inspect the end cover for physical damage, then inspect all air line fittings for corrosion; replace as necessary.
7. Clean and inspect the bolt, paying attention to the threads and O-ring grooves.

IMPORTANT: Use only the grease supplied with Bendix replacement kits.

8. Lubricate the O-rings, bolt O-ring grooves, sealing rings, and cartridge grooves. Lubricate the end cover bore for the bolt.
9. Install both O-rings on the cartridge bolt, then, using a twisting motion, insert the assembled desiccant cartridge bolt in the end cover.
10. Install the desiccant cartridge on the end cover, making sure the cartridge is properly seated and flush on the end cover.

NOTE: It may be necessary to rotate the cartridge slightly until the anti-rotation lugs are properly aligned and allow the cartridge to rest flush against the end cover.

11. Using a wrench or socket, tighten the desiccant cartridge bolt 50 lbf·ft (68 N·m). **Do not** overtorque.
12. Before placing the vehicle in service, perform the test below.
    - 12.1 Close all reservoir drain cocks.
    - 12.2 Build system pressure to governor cut-out, and note that the AD-IP air dryer purges with an audible escape of air.
    - 12.3 Fan the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-IP air dryer exhaust.
    - 12.4 Check for excessive leakage around the head of the desiccant cartridge where it contacts the end cover. With the compressor in loaded mode (compressing air), apply a soapy solution to these areas, and observe that any leakage does not exceed a 1-inch bubble in 1

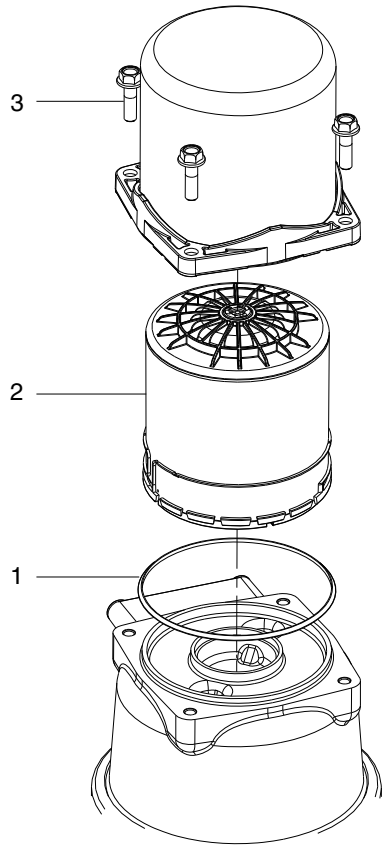
second. If leakage exceeds this measure, remove and re-install the desiccant cartridge.

Haldex PURest[1]

NOTE: The PURest cartridge contains both the desiccant and filter in one piece.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the tires.
2. Remove the four mounting bolts and discard. See **Fig. 1**. Lift the canister about 1/2 inch and remove.
3. Place the assembly upside-down as shown in **Fig. 2**. Press the cartridge down to compress the rubber spring then rotate counterclockwise 45 degrees to release the cartridge. The cartridge itself contains no hazardous material, but there may be a small amount of oil from the compressor.
4. Clean the inside of the canister and aluminum housing.
5. Remove the cartridge O-ring and discard.
6. Remove the new cartridge from the kit and make certain the rubber spring is attached. See **Fig. 3**.
7. Install the new cartridge into the canister. Align the slots on the cartridge with the dimplets inside the canister. Press the cartridge into the canister and rotate clockwise 45 degrees to engage the cartridge, as shown in **Fig. 4**.
8. Place a new O-ring on the aluminum housing.
9. Place the cartridge assembly on the air dryer housing and install four new mounting bolts. Use an alternating diagonal pattern and tighten the bolts 35 to 40 lbf·ft (47 to 54 N·m).
10. Before placing the vehicle in service, perform the test below.
    - 10.1 Start the engine and build air pressure to 100 psi (690 kPa) and shut-off the engine.
    - 10.2 Check for air leaks at the inlet, outlet, and canister assembly. Correct any leakage problem.

[1]Information in this section is provided by Haldex and is used with permission.



1. O-ring
2. Cartridge
3. Mounting Bolts

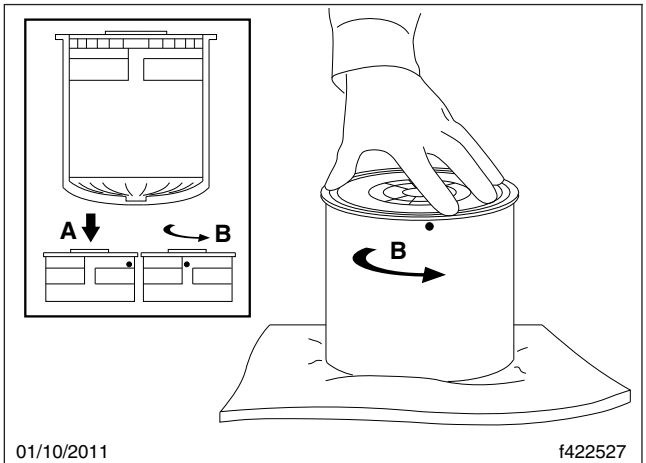
Fig. 1, PURest Air Dryer Assembly

- 10.3 Restart the engine and build-up pressure to cut-out pressure. At cut-out pressure, the air dryer purge valve opens and immediately expels a large volume of air, followed by a slow flow of air lasting approximately 30 seconds.

42–04 Camshaft Bracket Bushing Lubricating

Pump grease into the camshaft bracket bushing until it appears at the slack adjuster end of the bracket. See **Fig. 5**.

Use an NLGI Grade 1 or Grade 2 multipurpose chassis grease. If grease leaks out from under the cam head, the camshaft bracket grease seal is worn or



A. Canister/cartridge assembly shown upside-down.
B. Rotate the cartridge counterclockwise 45 degrees to release it from the canister.

Fig. 2, Releasing the Cartridge

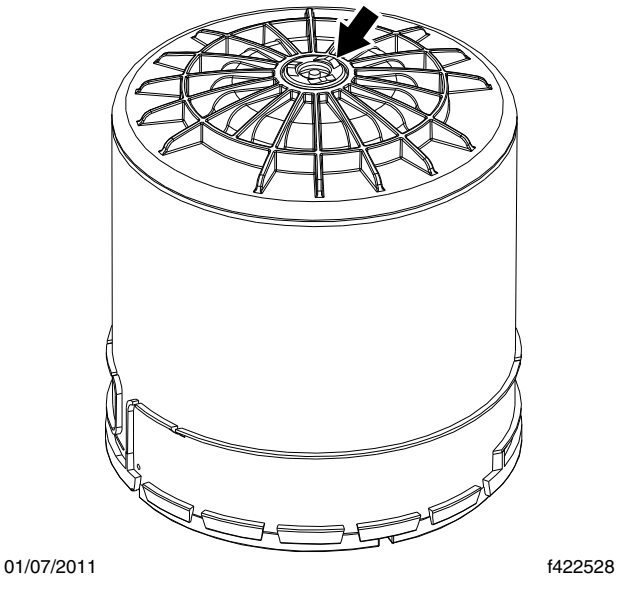
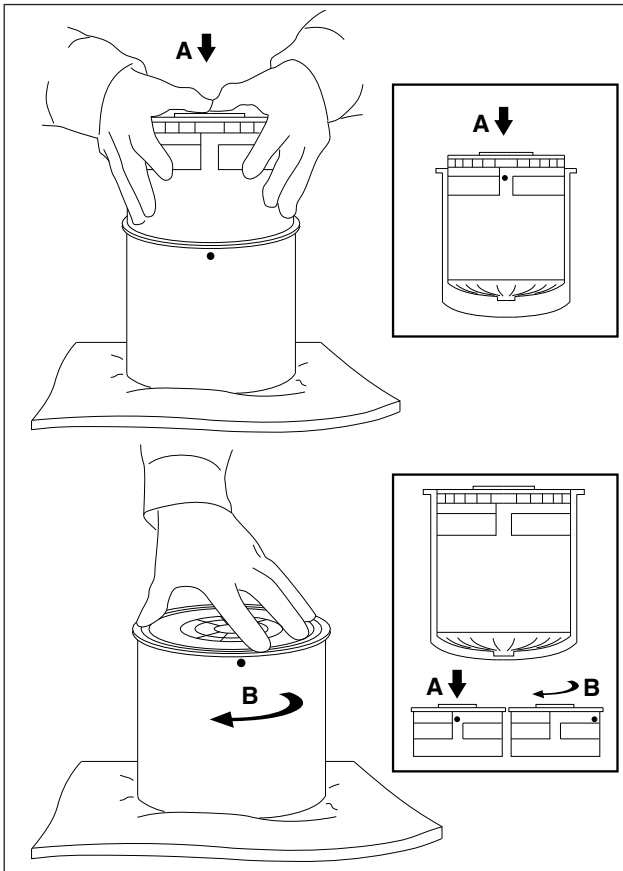


Fig. 3, New Cartridge with Rubber Spring

damaged. For grease seal replacement instructions, see **Group 42** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

Camshaft brackets without grease fittings are fitted with special seals and packed with extended-



A. Install the new cartridge into the canister.
B. Press the cartridge into the canister and rotate clockwise 45 degrees to engage the cartridge.

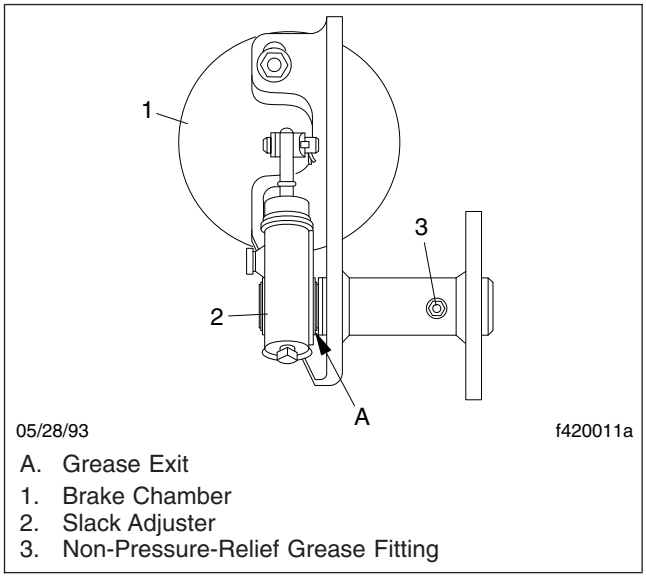
Fig. 4, Cartridge Rotation and Engagement

lubrication-interval chassis grease. Grease them only when the camshaft is disassembled for servicing.

42–05 Slack Adjuster Lubricating

IMPORTANT: Perform **Maintenance Operation 42–11** before lubricating the slack adjusters.

Automatic slack adjusters must be lubricated periodically to ensure proper brake operation.



A. Grease Exit
1. Brake Chamber
2. Slack Adjuster
3. Non-Pressure-Relief Grease Fitting

Fig. 5, Camshaft Bracket Bushing Lubrication

⚠ WARNING

Failure to lubricate slack adjusters could lead to dragging brakes or a brake failure, resulting in property damage, personal injury, or death.

Haldex

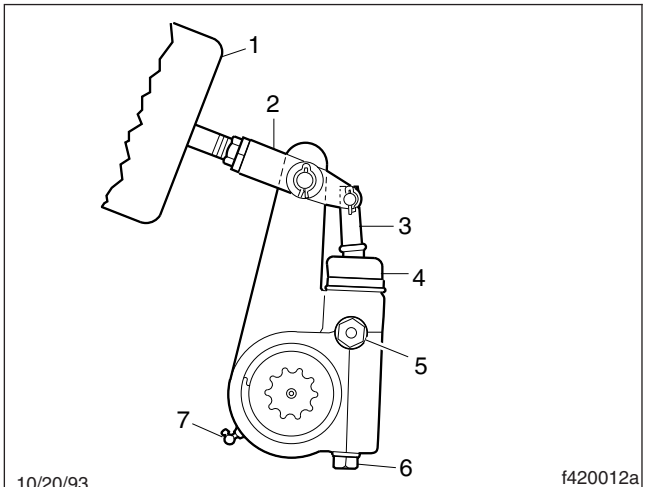
NOTICE

Do not use moly-disulfide-loaded grease or oil. Both the life and reliability of the slack adjuster will be reduced if this type of grease is used.

Lubricate a Haldex automatic slack adjuster at the grease fitting with any extreme-pressure NLGI Grade 1 or Grade 2 grease if the operating temperature is –20°F (–29°C) and above. If the operating temperature is below –20°F (–29°C), use a low-temperature extreme-pressure grease.

Meritor

Lubricate the slack adjuster at the grease fitting until grease is forced past the pressure-relief capscrew or past the gear splines around the inboard snap ring. Use high-temperature, NLGI Grade 1 waterproof grease. See **Fig. 6**.



1. Brake Chamber
2. Clevis
3. Actuator Rod
4. Boot
5. Pull-Pawl Seal
6. Manual Adjusting Nut
7. Grease Fitting (or Lube Plug)

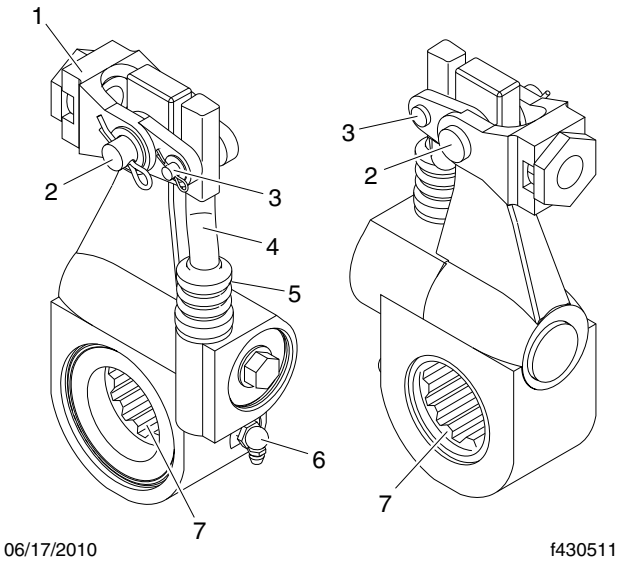
Fig. 6, Meritor Automatic Slack Adjuster (other slack adjustors are similar)

Bendix

Using a quality multipurpose chassis lubricant, NLGI Grade 2, lubricate the automatic slack adjuster through the lube fitting. See **Fig. 7**. Lubricate the slack adjuster until clean lubricant flows from the grease relief opening in the boot.

42–06 Foot Brake Valve Actuator Lubricating

1. Clean any dirt, gravel, and other foreign material from the base of the brake pedal, the plunger boot, and the brake base bracket.
2. Use light oil to lubricate the brake pedal roller and pivot pin.
3. Check the brake plunger boot for cracks, holes, or deterioration. Replace it if necessary.
4. Lift the edge of the brake plunger boot and check the plunger for existing lubrication.
   - 4.1 If the plunger is dry, remove it by removing the brake pedal and brake plunger boot. Lubricate the plunger and the inside surface of the boot with barium grease (p/n BW 246671) or Pennzoil Adhezoplex



1. Yoke
2. Yoke Pin
3. Link Pin
4. Link
5. Boot
6. Lube Fitting
7. Worm Gear

Fig. 7, Bendix Automatic Slack Adjuster

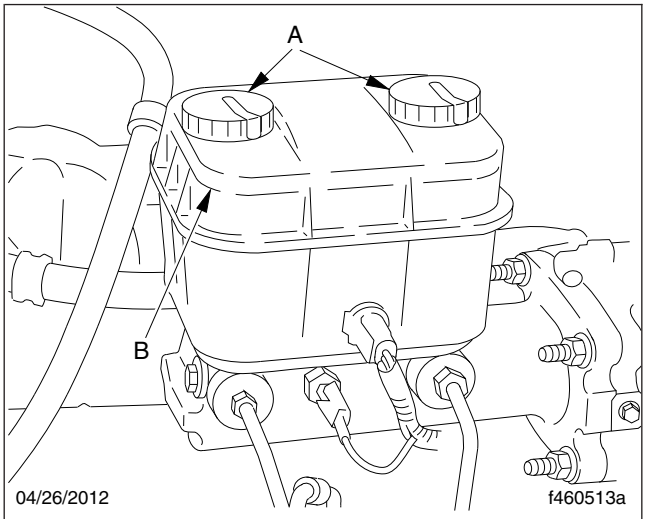
EP2. Install the plunger, boot, and the brake pedal.

IMPORTANT: Use only these approved lubricants.

4.2 If the plunger has grease on it, lift the edge of the brake plunger boot enough to apply 2 to 4 drops of light oil around the brake plunger, where it slides into the brake base bracket. Install the plunger boot around the brake base bracket.

42–07 Bendix Hydro-Max® Brake System Inspecting (front-engine diesel chassis)

1. Check the fluid level in the hydraulic brake fluid reservoir. If needed, fill the reservoir up to the ridge that surrounds the reservoir. See **Fig. 8**. Use only heavy-duty brake fluid, DOT 3.
2. Check all hydraulic lines and fittings for damage, leakage, or looseness.



A. Open caps and check fluid level.
B. Fill to this level.

Fig. 8, Hydraulic Brake Fluid Reservoir

Replace damaged or leaking components, and tighten loose fittings.

3. Check the brake module for leaks. If leaks are found, repair or replace the brake module. See **Group 42** of the *Recreational Vehicle Chassis Workshop Manual* for replacement instructions, or take the vehicle to an authorized Freightliner Chassis dealer.
4. Check the electrical connections and harnesses. Make sure the connectors are fully seated and the harnesses are not chafed or cut. Repair or replace any damaged harness. Disconnect any loose connectors and inspect the terminals for corrosion. If corrosion is present, replace the terminals. If corrosion is not present, reconnect the connector.
5. Check the fuse for the hydraulic brake booster pump, as follows.
   - 5.1 Open the cover to the main power distribution module (PDM).
   - 5.2 Pull the fuse in position F6 for the Hydro-Max relay.
   - 5.3 Inspect the relay to make sure the fuse is not damaged. If the fuse is damaged, install a new fuse. If the fuse is not damaged, install the fuse in position F6.
   - 5.4 Close the PDM cover.

6. Check the operation of the Hydro-Max brake booster, as follows.

   6.1 With the ignition off, depress the brake pedal and listen for the back-up motor to engage. Also note that the pedal force relieves; the pedal should depress easily.

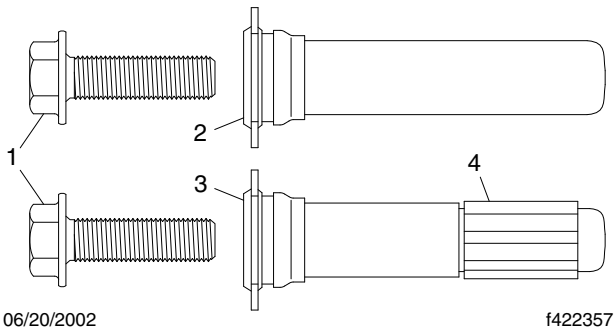
   6.2 With the ignition on, engine running, parking brake released, ensure that the BRAKE warning indicator light is **not** on. This is a dual indicator and indicates that the parking brake is set, and warns if there is a hydro-max failure other than loss of back-up motor power.

42–08 Brake Caliper Slide Pin Lubricating, Bosch Brakes (front-engine diesel chassis)

NOTE: There is no set maintenance interval for lubricating pin-slide hydraulic disc brake calipers.

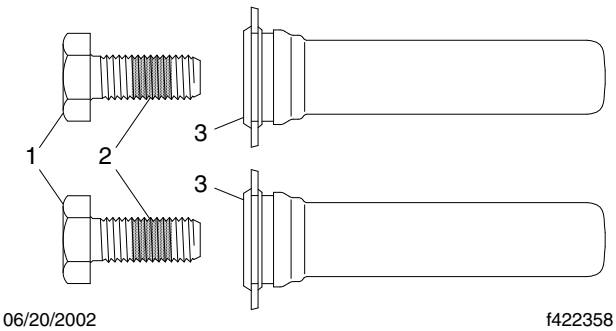
Apply 1/8 oz (3.5 g) Aeroshell grade 5 grease to each of the two guide pin and guide pin bore sets. See the *Bosch Pin Slide Disc Brakes Service Manual* for additional information.

IMPORTANT: The later ZOH-T caliper has important differences from the early ZOPS caliper. ZOPS calipers (since 1998) and ZOH-T calipers (since 2002) use different slide pins and bolts. See **Fig. 9** and **Fig. 10**. The later trailing pin is identified by notches and has a rubber bushing. Flange-head instead of hexhead bolts are used with the later caliper. The later bolts have a fine thread rather than a coarse thread pitch, are longer, differently colored, and are tightened to a higher torque specification. Use only the ZOH-T bolts to assemble a ZOH-T caliper. The ZOPS caliper bolts have a different thread pitch and will not assemble correctly in a ZOH-T caliper mounting. Also, the ZOH-T bolts will not assemble correctly in a ZOPS caliper. **Do not interchange parts**. It is permissible to use both ZOH-T pins and ZOH-T bolts in a ZOPS anchor plate, but they must be replaced as sets. Both the pins and the bolts must be changed.



1. Flange-Head Bolt
2. Leading Pin
3. Trailing Pin
4. Rubber Bushing

Fig. 9, ZOH-T Slide Pins and Bolts



1. Hexhead Bolt
2. Blue Patch
3. Slide Pin

Fig. 10, ZOPS Slide Pins and Bolts

⚠ DANGER

The correct pins, bolts, and bolt torque must be used. If not, brake function could be impaired and lead to loss of control of the vehicle, which could result in personal injury, death, or property damage.

IMPORTANT: The ZOH-T caliper assembly is similar in appearance to the existing ZOPS caliper. The only obvious difference is that one of the anchor plate slide pins (trailing side) has notches for identification. With ZOH-T calipers, install the solid pin (no bushing) only in the anchor plate leading hole position. Install the pin with the rubber bushing and notches only in the

anchor plate trailing hole position. Tighten the leading-side pin first, then tighten the trailing-side pin.

Tighten ZOH-T bolts 93 to 107 lbf·ft (126 to 145 N·m).

Tighten ZOPS bolts 70 to 80 lbf·ft (95 to 108 N·m).

42–09 Brake Lines Checking, Hydraulic Disc or Air Brakes

Check all hydraulic/air lines and fittings for damage, leakage, or looseness.

Replace damaged or leaking components, and tighten loose fittings.

42–10 Brake Lining Wear Checking, Hydraulic Disc Brakes (front-engine diesel chassis)

Before checking lining wear with the wheel removed, review the following brake lining exposure warnings.

⚠ WARNING

Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. Unless exposure can be reduced below legal limits, wear an air purifying respirator approved by MSHA or NIOSH at all times when servicing the brakes, starting with removal of the wheels and continuing through assembly.

To minimize the possibility of creating airborne brake lining dust, clean the dust from the brake rotor, brake caliper, and brake assembly, using an industrial-type vacuum cleaner equipped with a high-efficiency filter system. Then, using a rag soaked in water and wrung until nearly dry, remove any remaining dust. Do not use compressed air or dry brushing to clean the brake assembly.

1. Apply the brake and chock the tires to prevent vehicle movement.
2. Check the brake lining wear. On front and rear axles, replace linings worn to less than 3/16 inch (4.8 mm).
3. Make sure that the brake rotor and linings are free of oil and grease.

NOTE: To replace the brake linings, see the applicable foundation brake section in **Group 42** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

42–11 Brake Inspecting

IMPORTANT: This procedure should be performed prior to lubrication of the brake components.

Parking Brake Operational Check

⚠ CAUTION

Perform the following check in a clear safe area. If the parking brakes fail to hold the vehicle, personal injury or property damage may result.

1. With the engine running, and air pressure at cut-out pressure, set the parking brake.
2. Put the vehicle in the lowest gear and gently attempt to move it forward. The vehicle should not move. If the vehicle moves, the parking brakes are not operating correctly and must be repaired before the vehicle is returned to service. See **Group 42** of the *Recreational Vehicle Chassis Workshop Manual* for repair procedures, or take the vehicle to an authorized Freightliner dealer.

Brake Component Inspection

1. Park the vehicle on a level surface, set the parking brake, and chock the tires. Once the tires are chocked, release the parking brake.

⚠ WARNING

Manually adjusting an automatic slack adjuster to bring the pushrod stroke within legal limits is likely masking a mechanical problem. Adjustment is not repairing. Before adjusting an automatic slack adjuster, troubleshoot the foundation brake

system and inspect it for worn or damaged components. Improperly maintaining the vehicle braking system may lead to brake failure, resulting in property damage, personal injury, or death.

2. With the engine off, and 100 psi (689 kPa) of air tank pressure, have an assistant apply and hold an 80 to 90 psi (550 to 620 kPa) brake application.
3. Check to see if the colored over-stroke band on each brake chamber pushrod is exposed.

   If a band shows, the stroke is too long. Check the foundation brake components for wear or damage, and repair as needed. See **Group 42** of the *Recreational Vehicle Chassis Workshop Manual* for inspection, troubleshooting, and repair procedures, or take the vehicle to an authorized Freightliner dealer.
4. Measure the applied chamber stroke. See **Table 2** for the proper stroke for the type of chamber being used. If the stroke is too short, the brakes may drag or will not fully apply. Check for improper operation or adjustment of the automatic slack adjuster. See **Group 42** of the *Recreational Vehicle Chassis Workshop Manual* for inspection and troubleshooting procedures, or take the vehicle to an authorized Freightliner dealer.
5. Start the engine and build air pressure to at least 100 psi (689 kPa). Shut down the engine.
6. Check all of the foundation brake components for damage, wear, and loose or missing parts. Repair as needed. See **Group 42** of the *Recreational Vehicle Chassis Workshop Manual* for repair procedures, or take the vehicle to an authorized Freightliner dealer.

42–12 Meritor Roller Pin Lubricating

⚠ WARNING

Remove all grease or oil from the camshaft head, rollers and brake linings. Always replace linings contaminated with grease or oil, which can increase stopping distances, causing component damage and serious personal injury.

For Q and P series Meritor brakes, lube the cam anchor and cam roller pins when the brake is disassembled, or every six months, with Meritor specification grease 0-617-A or 0-617-B. See **Fig. 11** for roller and anchor pin lubrication points.

Brake Chamber Stroke Specifications

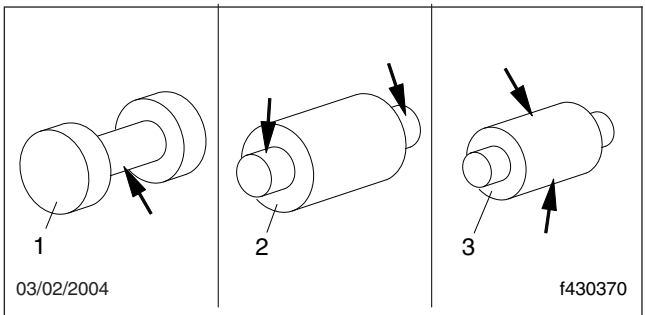
Chamber			Max Applied Stroke: inch (mm)
Manufacturer	Type*	Size†	
Haldex	Standard Stroke	12	1-3/8 (35)
		16	1-3/4 (44)
		20	
		24	
	2-1/2-Inch Extended Stroke	24	2 (51)
	3-Inch Extended Stroke	24	2-1/2 (64)
	Standard Stroke	30	2 (51)
	Long Stroke	30	2-1/2 (64)

Brake Chamber Stroke Specifications			
Chamber			Max Applied Stroke: inch (mm)
Manufacturer	Type*	Size†	
Meritor	Standard Stroke	9	Less than 1-1/2 (38)
		12	
		16	Less than 1-3/4 (44)
		20	
		24	Less than 1-7/8 (48)
	Long Stroke	24	Less than 2 (51)
	Standard Stroke	30	

* Long stroke design is indicated by a tag, or embossing, on the brake chamber.

† Specifications are relative to a brake application with 80 to 90 psi (550 to 620 kPa) air pressure in the brake chambers.

Table 2, Brake Chamber Stroke Specifications



1. Cam Roller Pin Lube Point (Q Series)
2. Cam Roller Pin Lube Points (Q, Q Plus, and P Series)
3. Cam Anchor Pin Lube Points (Q, Q Plus, and P Series)

Fig. 11, Cam and Anchor Roller Pin Lubrication Points

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
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Hydraulic Reservoir Filter Changing (metal reservoir only)	46–06
Power Steering Fluid and Filter Changing	46–03
Power Steering Reservoir Fluid Level Checking	46–02
Safety Precautions	
Steering Driveline Lubricating	46–04
Steering Gear Lubricating	46–05

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

46–01 Drag Link Lubricating

1. Using a clean rag, wipe the dirt from both grease fittings on the drag link.
2. Using a pressure gun, apply multipurpose chassis grease at the grease fittings until old grease is forced out of the socket.

NOTE: Use multipurpose chassis grease NLGI grade 1 (6% 12-hydroxy lithium stearate grease) or NLGI grade 2 (8% 12-hydroxy lithium stearate grease). The grade 2 chassis grease is preferred.

46–02 Power Steering Reservoir Fluid Level Checking

Side-Mounted

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the rear tires.
2. Clean around the power steering reservoir dipstick (fill cap) with a clean rag, then remove the dipstick.

⚠ WARNING

Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.

3. With the power steering fluid at operating temperature, check the fluid level on the dipstick. If below the "Add" mark, add enough fluid to bring the level up to the "Full" mark on the dipstick. See **Table 1** for approved power steering fluid.

Approved Power Steering Fluid	
Fluid Type	**Approved Fluid***
Automatic Transmission Fluid	Dexron® III

* Use the same lubricant when assembling parts as is used in the power steering system.

Table 1, Approved Power Steering Fluid

4. Install the dipstick (fill cap) in the power steering reservoir.

Rear-Mounted

1. Park the vehicle on a level surface, shut down the engine, and apply the parking brake. Chock the rear tires.
2. Clean around the power steering reservoir cap with a clean rag, then remove the reservoir cap. See **Fig. 1**.

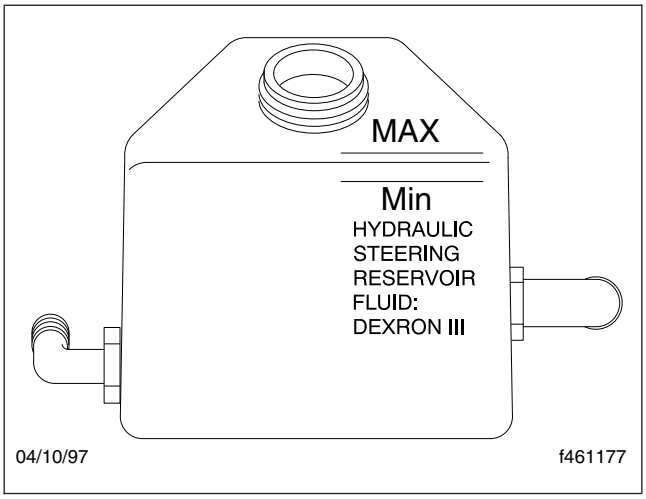


Fig. 1, Steering System Hydraulic Fluid Reservoir (rear-mounted)

⚠ WARNING

Fill only with approved clean fluid. Do not mix fluid types. Any mixture or any unapproved fluid could lead to seal deterioration and leaks. Fluid

leakage could cause loss of power steering assist, possibly resulting in personal injury and property damage.

IMPORTANT: Do not confuse coolant with hydraulic fluid. Both are pink in color.

3. Fill the reservoir to a level between the MIN and MAX marks. Use only Dexron III automatic transmission fluid (ATF), or an equivalent. See **Table 1** for approved power steering fluid.
4. Replace the reservoir cap.

46–03 Power Steering Fluid and Filter Changing

⚠ WARNING

Fill only with approved clean fluid. Failure to use the proper fluid could cause seal deterioration and leaks. Fluid leaks could eventually cause loss of power steering assist. This could lead to an accident resulting in personal injury or property damage. Wear eye protection when changing the fluid and filter.

1. Park the vehicle on a level surface, shut down the engine, and set the parking brake. Chock the rear tires.
2. Place a drain pan under the power steering reservoir.
3. Remove the steering gear-to-reservoir return hose at the reservoir and position it to drain into the pan.
4. Plug the return line fitting on the reservoir.
5. Remove the reservoir cover.

   For the 1.6- and 2-quart reservoir, unscrew and remove the reservoir cover. See **Fig. 2**.

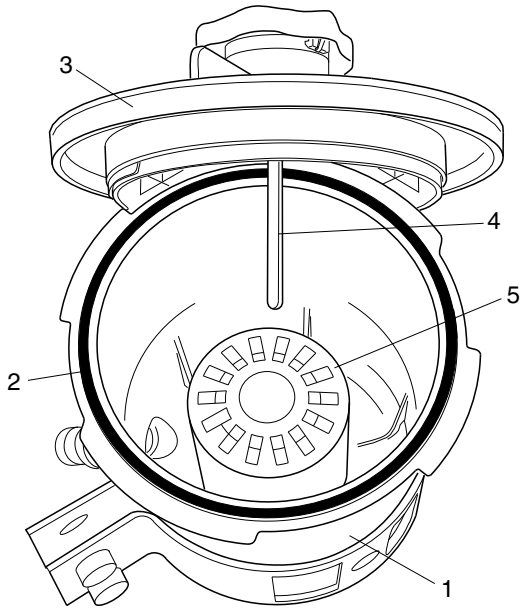
   For the 4-quart reservoir, loosen and then remove the retaining ring, filter top plate, and gasket. See **Fig. 3**.

NOTE: Always replace the power steering reservoir filter when changing the fluid.

6. Remove the power steering filter. It may be necessary to wiggle the filter to remove it from its base. Do not use pliers to aid in removal of the filter; pliers could cause metal chips to enter the steering system.
7. Clean the inside of the reservoir using a lint-free cloth.
8. Raise the front of the vehicle with a floor jack and support it with jack stands.
9. Place the disconnected end of the steering gear-to-reservoir hose in a drain pan.

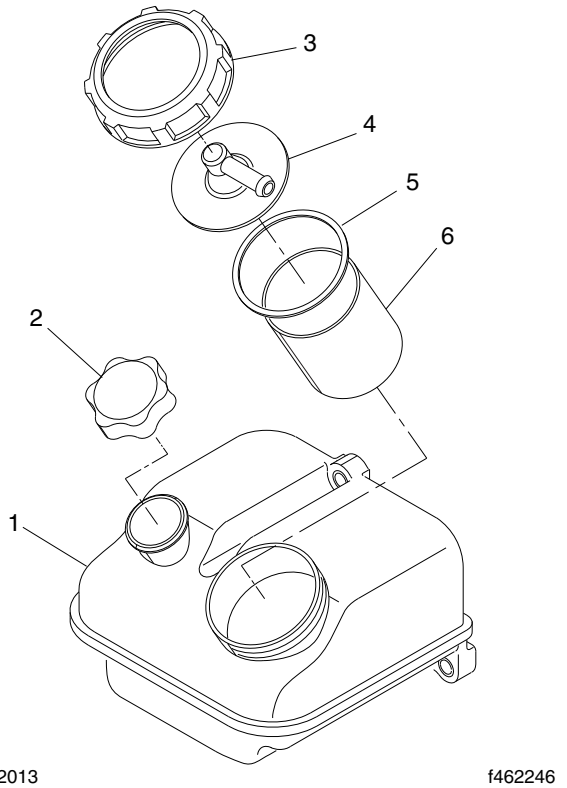
IMPORTANT: Do not start the engine while draining the system.

10. Have someone turn the steering wheel to full lock left and right several times until clean power steering fluid flows from the hose into the drain pan. Add fluid to the reservoir as needed.
11. Once clean fluid comes out of the hose, remove the plug from the reservoir and reconnect the steering gear-to-reservoir hose to the reservoir.



1. Power Steering Fluid Reservoir
2. Gasket
3. Reservoir Cover
4. Dipstick
5. Filter

Fig. 2, 1.6- and 2-Quart Reservoir



1. Power Steering Fluid Reservoir
2. Reservoir Fill Cap
3. Retaining Ring
4. Filter Top Plate
5. Gasket
6. Filter

Fig. 3, 4-Quart Reservoir

12. Install a new power steering filter in the reservoir.
13. Inspect the reservoir cover and gasket for any damage. Replace the reservoir cover or gasket if needed.
14. Install the reservoir cover.

    For the 1.6- and 2-quart reservoir, install the cover and hand-tighten.

    For the 4-quart reservoir, install the gasket, filter top plate, and retaining ring, then hand-tighten the retaining ring.
15. Fill the power steering reservoir with Dexron III.

    Fill the 1.6- and 2-quart reservoir to the MAX COLD mark.

    Fill the 4-quart reservoir to the mark *between* the MIN COLD and MAX HOT marks.

IMPORTANT: Do not allow the reservoir to empty and pull air into the power steering system.

16. Start the engine and let it idle for about 15 seconds, then check the reservoir and add fluid as needed.

    Since the power steering lines were drained, this will need to be done several times before the reservoir will remain full.
17. Start the engine and operate it at idle. Turn the steering wheel to full lock left and right to adjust the fluid level and remove any air from the power steering pump and gear. Recheck the fluid level. Add fluid as needed. The system is properly bled when the steering pump does not labor when turning the wheel.
18. Remove the jackstands and lower the vehicle.

46–04 Steering Driveline Lubricating

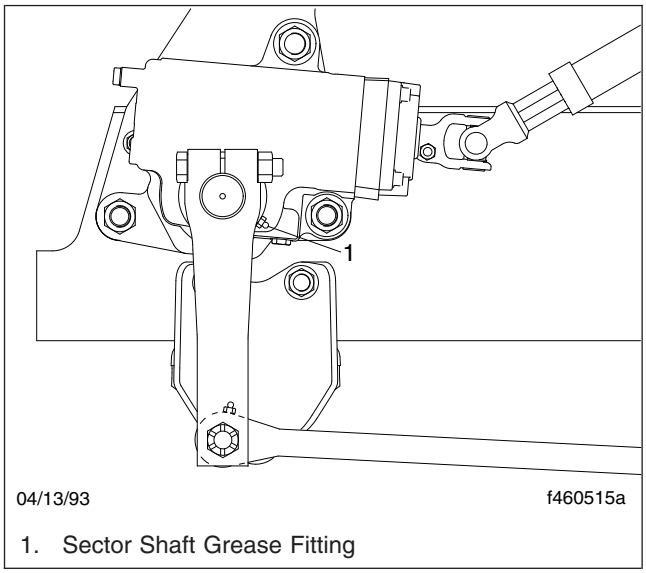
Wipe the grease fittings clean. Using a pressure gun, apply a lithium-based grease (NLGI grade 2) sparingly to the universal joints and slip-joint splines.

46–05 Steering Gear Lubricating

1. Wipe off debris from the grease fitting.
2. Using a hand-type grease gun, apply multipurpose chassis grease until the grease starts coming out of the sector shaft dirt and water seal. **Figure 4** shows the location of the sector shaft grease fitting.

46–06 Hydraulic Reservoir Filter Changing (metal reservoir only)

NOTE: On XC chassis vehicles with a side-mounted radiator, the hydraulic reservoir supplies both the steering and the fan circuits.



1. Sector Shaft Grease Fitting

Fig. 4, Sector Shaft Lubricating

1. Drain the entire steering and fan hydraulic systems.
2. Remove the reservoir lid and remove the nut that secures the filter.
3. Remove the old filter and install the new filter.
4. Install the filter nut and tighten it securely.
5. Fill the reservoir with Dexron III.
6. Start the engine, run it for five seconds, then shut down the engine.
7. Fill the reservoir with Dexron III.
8. Start the engine. Turn the steering wheel lock-to-lock several times until the steering wheel turns easily. Shut down the engine.
9. Fill the reservoir with Dexron III.

NOTE: The steering circuit is now purged. Follow the remaining steps to purge the fan circuit.

10. Start the engine. Run the engine at half-throttle until the fans engage (loud chirping sound). Shut down the engine.
11. The fan circuit is now purged. Top off the reservoir fluid and install the reservoir lid.

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Fuel/Water Separator Element Replacing	47–02
Safety Precautions	

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

47–01 Fuel Tank Mounts and Fuel Line Checking

⚠ WARNING

Inspect the components as described below. Failure to perform these inspections could result in the failure of the fuel tank mounting assembly and loss of vehicle control, possibly causing personal injury or death, or property damage.

1. Chock the tires. Working at the front of the vehicle or at the rear of the vehicle, raise the vehicle so that the tires just clear the ground and so that the suspension is fully extended. Place safety stands under the vehicle frame.
2. Check the T-bolts that attach the fuel tank mounting straps to the mounting brackets. Check to see that the nuts are tight.
3. Inspect the fuel tank straps for damage or wear. Replace them if necessary.
4. Inspect the fuel tank for leaks or damage. Replace the tank if necessary.

IMPORTANT: Do not attempt to repair a damaged fuel tank; always replace a damaged fuel tank.

5. Inspect the fuel lines for damage or wear.
6. Remove the safety stands and lower the vehicle. Remove the chocks from the tires.

47–02 Fuel/Water Separator Element Replacing

Alliance

The only maintenance necessary on an Alliance fuel/water separator is to replace the filter element.

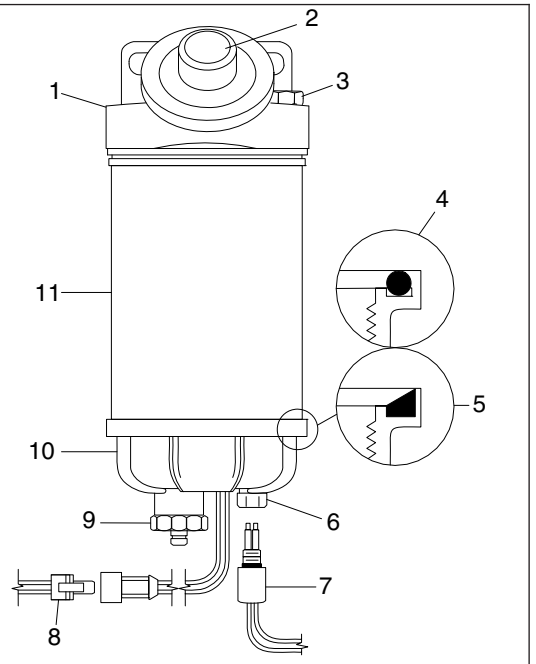
⚠ WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Drain off some fuel by loosening the vent plug and opening the drain valve. See **Fig. 1**.
2. Disconnect the water sensor and heater connections if equipped.
3. Remove the element and bowl together, by turning counterclockwise.
4. Remove the bowl from the element and clean the O-ring seating surface.
5. Apply a coating of clean fuel or motor oil to the new O-ring and element seal.
6. Spin the bowl onto the new element, then spin them both onto the filter head, snugly, by hand only.

IMPORTANT: Do not use tools to tighten the bowl and element.

7. Connect the water sensor and heater connectors if equipped.
8. If equipped with a primer pump, prime the fuel/water separator.
   - 8.1 Loosen the vent plug. Then operate the primer pump until the fuel purges at the vent plug.
   - 8.2 Close the vent plug.
9. Start the engine and check for fuel leaks.
10. Shut down the engine and correct any fuel leaks.



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1. Mounting Head
2. Fuel Primer Pump
3. Vent Plug
4. Bowl O-Ring
5. Bowl Gasket
6. Bowl Probe Plug
7. Water Sensor Probe
8. Heater Connector
9. Drain Plug
10. Sight Bowl
11. Filter Element

Fig. 1, Alliance Fuel/Water Separator

Davco Fuel Pro® 232 and 233

Replace the fuel/water separator element, shown in **Fig. 2**, only when the filter element is completely covered.

⚠ WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Drain the fuel below the collar level.
2. Using Davco wrench 232002, remove the filter collar. Then remove the filter cover.
3. Remove the element and dispose of it properly.
4. Install a new element. Make sure the grommet is in place on the filter stud.
5. Install a new cover seal on the filter cover.
6. Using the collar, attach the filter cover with the spring to the base.

IMPORTANT: Tighten the collar by hand only.

7. Remove the filter vent. Then fill the fuel/water separator with fuel until the fuel level is 1 inch (2.5 cm) above the collar.
8. Install the filter vent on the fuel/water separator.
9. Start the engine and raise the rpm for one minute to purge air.

Davco Fuel Pro® 382

Replace the fuel/water separator element only when the filter element is completely covered.

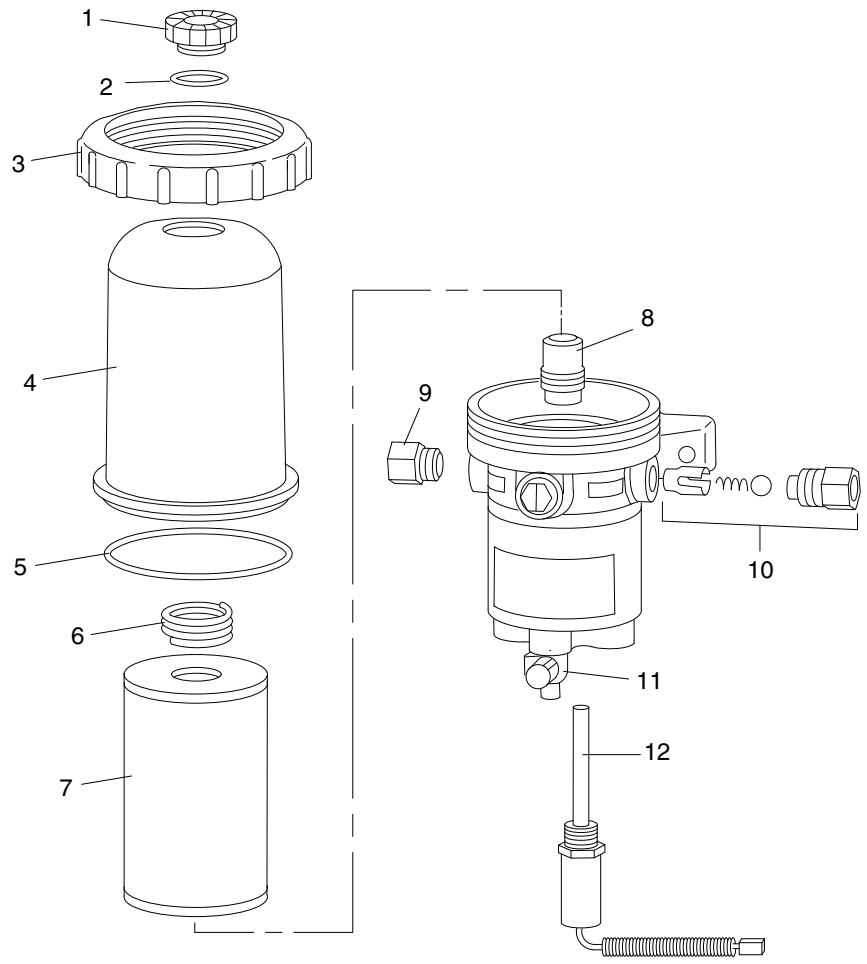
⚠ WARNING

Diesel fuel is flammable and can ignite if exposed to an open flame, intense heat, or other ignition source. Do not drain fuel near, or expose fuel vapor to open flame or intense heat. Exposure to open flame or intense heat could start a fire, possibly resulting in personal injury or property damage. When working on a fuel system, have a fire extinguisher within easy reach.

1. Drain the fuel below the collar level. See **Fig. 3**.
2. Using Davco wrench 380134 or 382002, remove the filter collar. Then remove the filter cover.
3. Remove the element and dispose of it properly.
4. Install a new element. Make sure the grommet is in place on the filter stud.
5. Install a new cover seal on the filter cover.
6. Using the collar, attach the filter cover with the spring to the base.

IMPORTANT: Tighten the collar by hand only.

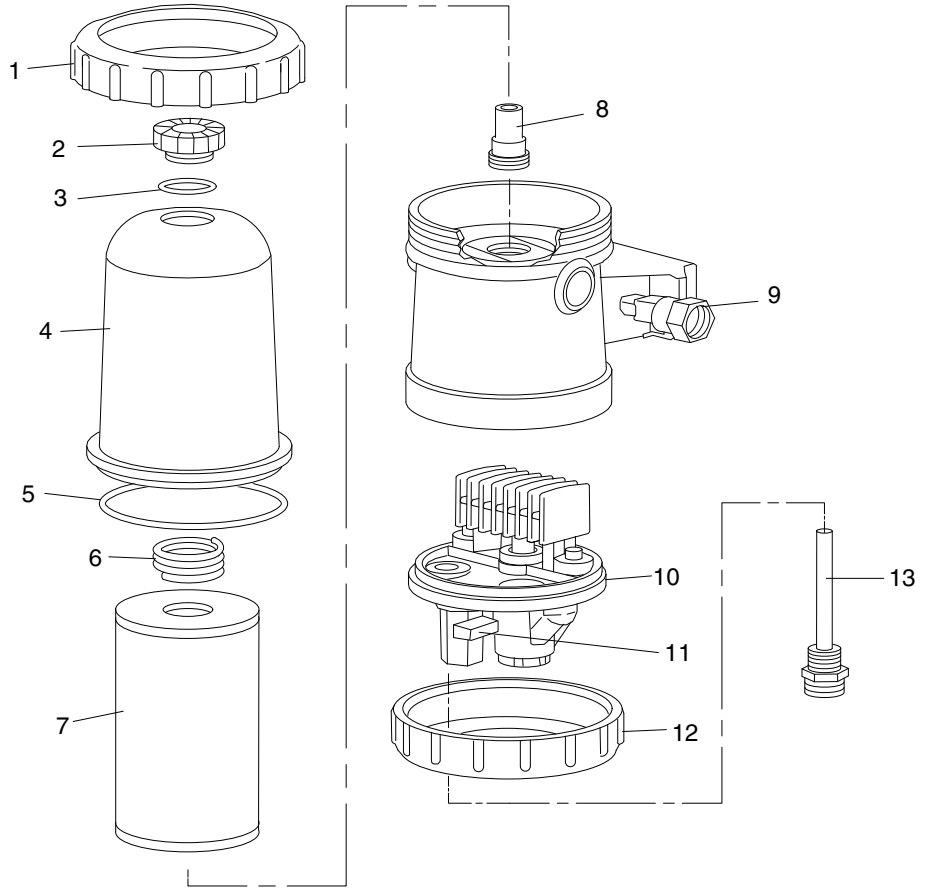
7. Remove the filter vent. Then fill the fuel/water separator with fuel until the fuel level is 1 inch (2.5 cm) above the collar.
8. Install the filter vent on the fuel/water separator.



1. Filter Vent
2. Vent Seal
3. Filter Collar
4. Filter Cover
5. Cover Seal
6. Filter Spring
7. Filter Element
8. Temporary Filter Stud
9. Fuel Outlet
10. Check Valve Fuel Inlet
11. Drain
12. Electric Filter Preheater (optional)

Fig. 2, Davco Fuel Pro® 232 and 233

9. Start the engine and raise the rpm for one minute to purge air.



1. Filter Collar
2. Filter Vent
3. Vent Seal
4. Filter Cover
5. Cover Seal
6. Filter Spring
7. Filter Element
8. Temporary Filter Stud
9. Check Valve Fuel Inlet
10. Fluid Heater/Bottom Plate and Seal
11. Drain
12. Bottom Plate Collar
13. Electric Heater (optional)

Fig. 3, Davco Fuel Pro® 382

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Title of Maintenance Operation (MOP)	MOP Number
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Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

49–01 Exhaust System Inspecting (Noise Emission Control)

The exhaust system must be free of leaks, binding, grounding, and excessive vibrations. In addition to inspecting the exhaust system at the scheduled maintenance interval, inspect the exhaust system if the noise level of the vehicle has increased. Replace parts that show leakage, wear, or damage, with genuine Freightliner parts.

These conditions are usually caused by loose, broken, or misaligned clamps, brackets, or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align or replace as necessary. For alignment or adjustment instructions, see **Group 49** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.

EPA10 Exhaust System

Definitions of Aftertreatment System (ATS) Terms

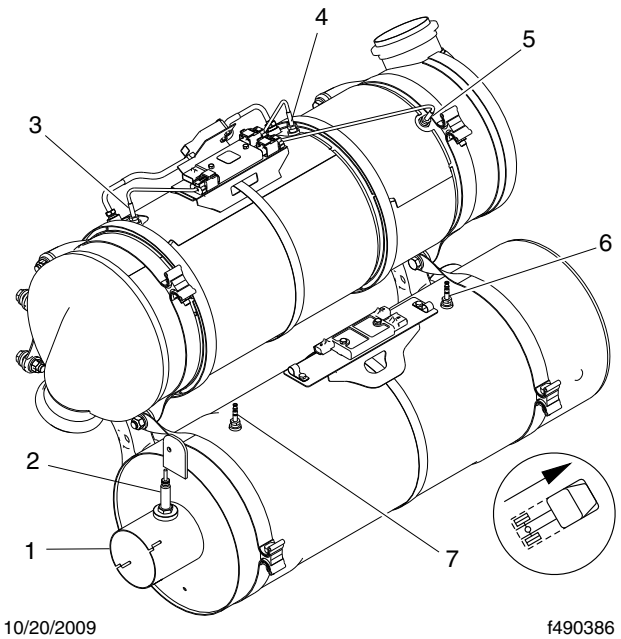
Refer to the following list of definitions of ATS terms and components.

- Aftertreatment System (ATS)—the entire exhaust system from the turbocharger to the tail pipe, including the Selective Catalytic Reduction (SCR) components.
- Aftertreatment Device (ATD)—a device that removes pollutants from exhaust gas after the gas leaves the combustion chamber.
- BlueTec®—Daimler's proprietary SCR technology.
- Diesel Oxidation Catalyst (DOC)—a flow-through device that enhances the oxidation of hydrocarbons in the ATD.
- Diesel Particulate Filter (DPF)—a component in the ATD that traps particulate matter from the exhaust gas.
- Diesel Exhaust Fluid (DEF)—the chemical agent that reacts with the exhaust gases in the SCR to reduce NOx.
- DEF Pump—filters and supplies DEF to the DEF metering unit.
- DEF Tank—holds DEF and regulates its temperature.
- DEF Metering Unit—mixes DEF with compressed air, and meters this mixture into the exhaust flow via an injection nozzle.
- SCR Catalyst—the housing containing a treated ceramic flow-through block where the DEF and exhaust gases undergo selective catalytic reduction.
- Selective Catalytic Reduction (SCR)—a process used to reduce NOx emissions.

Inspection

IMPORTANT: The Environmental Protection Agency's 2010 regulations mandate lowered exhaust emissions, thus requiring exhaust system components that reduce emissions. In particular the aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. See **Fig. 1** for Cummins ATD sensor locations. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse



1. Exhaust Outlet
2. SCR Outlet NOx Sensor
3. DPF Outlet Pressure Sensor
4. DPF Intake Pressure Sensor
5. DPF Inlet Temperature Sensor
6. SCR Inlet Temperature Sensor
7. SCR Outlet Temperature Sensor

Fig. 1, Cummins ATD Sensor Locations

seal clamps. Once a seal clamp is loosened or removed, it must be replaced.

3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD. No leaks are allowed anywhere in the system.
6. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
7. Check the DPF exterior surface for dents or other damage. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check the SCR catalyst for dents and other damage.
9. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.

NOTE: Diesel exhaust fluid creeps, causing white crystals to form around the line fittings. The presence of crystals does not mean the system has a leak. Replacing fittings or troubleshooting components is not necessary unless there is a system failure or a fault code.

10. Check the DEF tank, pump, metering unit, and lines for leaks. See **Group 49** of the *Recreational Vehicle Chassis Workshop Manual* for repair procedures.
11. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.

Diesel Exhaust Fluid (DEF) Filter Replacement

The Environmental Protection Agency's 2010 regulations require lower nitrogen oxide (NOx) exhaust emissions. Selective catalytic reduction (SCR) uses diesel exhaust fluid (DEF) to lower NOx emissions in the vehicle exhaust. A filter in the DEF pump prevents clogging of the DEF metering unit injection nozzle.

See the engine manufacturer's maintenance manual for DEF filter replacement instructions and maintenance intervals.

EPA07 Exhaust System

Definitions of ATS Terms

Refer to the following list of definitions of ATS terms and components.

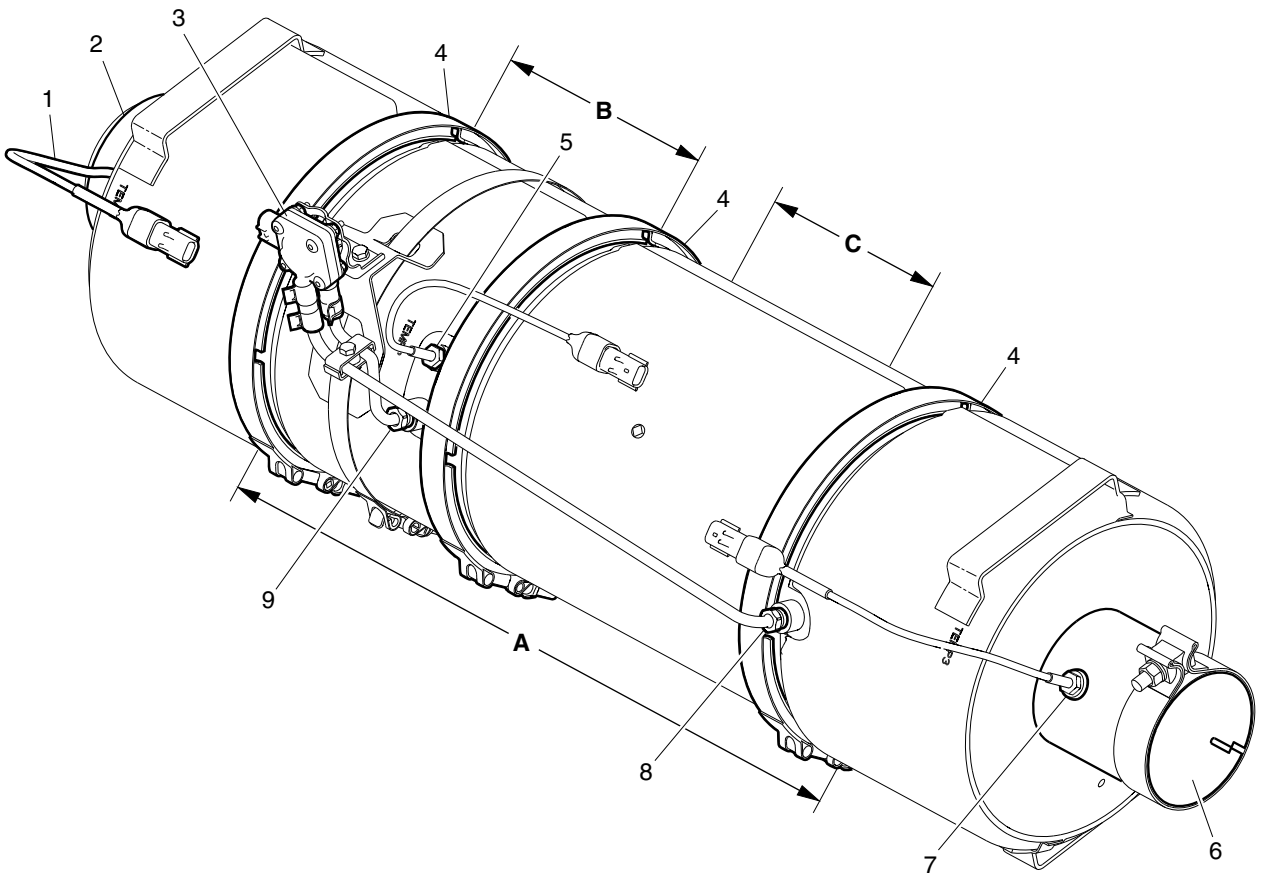
- Aftertreatment System (ATS) — the entire exhaust system from the turbocharger to the tail pipe.
- Aftertreatment Device (ATD)—a muffler-like canister that houses a DPF and sensors.

- Diesel Particulate Filter (DPF)—a filter that collects and holds particulate matter (soot and ash).
- Diesel Oxidation Catalyst (DOC)—oxidizes hydrocarbons and reduces NOx.
- Sensors—detect temperatures and pressure within the ATS.
- Diffuser—a device, used as a deflector, for distributing, mixing, and reducing the velocity of air flow.

Inspection

IMPORTANT: The Environmental Protection Agency's 2007 regulations require lower exhaust emissions, thus requiring new exhaust system components. See **Fig. 2**. In particular the aftertreatment device (ATD), which is part of the aftertreatment system (ATS), requires special attention during regularly scheduled maintenance inspections. If any discrepancies are discovered, refer to the engine manufacturer's service literature for repair instructions.

1. Check for leakage at the clamp that attaches the exhaust pipe to the turbocharger exhaust outlet. If leakage exists, tighten the nut on the clamp to the required torque. If leakage persists, install a new clamp.
2. Check the exhaust pipe, bellows, and each exhaust seal clamp for leakage, wear, cracks, or damage. Replace damaged components as needed. If leakage exists at a clamp, tighten the nuts to the required torque. If leakage persists, install a new exhaust seal clamp. Do not reuse seal clamps. Once a seal clamp is loosened or removed, it must be replaced.
3. If present, check the condition of the insulation material around the exhaust pipe between the turbocharger and the ATD, as well as the exhaust wrap from the ATD to the diffuser.
4. Check the ATD mounting bands for tightness. Tighten to 30 lbf·ft (41 N·m) if needed. Do not overtighten.
5. Check for leaks around the clamps that attach the ATD in the ATS, and around the clamps that retain the DPF in the ATD. No leaks are allowed anywhere in the system.
6. Check all sensors attached to the ATD for leaks or damaged wires. No leaks are allowed.
7. Check the DPF exterior surface for dents or other damage. See **Fig. 2**, Item A. A dent over 3 inches (76 mm) in diameter and 1/4-inch (6-mm) deep could cause internal damage to the DPF, causing it to malfunction.
8. Check for heat discoloration on the surface of the ATD. Heat discoloration may indicate internal damage; especially around the DPF.
9. Check any wires, lines, or hoses within 4 inches (10 cm) of the exhaust system for heat damage. Repair or reroute as needed.



A. Inspect this area of the canister for dents.
B. DOC Area
C. DPF Area

1. Inlet Temperature Sensor
2. Marmon Fitting at Inlet from Turbocharger
3. Sensor Housing
4. DPF V-Band Mounting Clamps
5. Inlet Temperature Sensor
6. Exhaust Outlet to Diffuser
7. Outlet Temperature Sensor
8. DPF Outlet Pressure Sensor
9. DPF Intake Pressure Sensor

Fig. 2, Cummins Aftertreatment Device

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Title of Maintenance Operation (MOP)	MOP Number
Battery Voltage Checking	54–02
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54–01 Ground Cables Checking and Cleaning

Check that the ground cables are clean, undamaged, and tight. If needed, disconnect them, clean the mating surfaces with a soda solution, then connect them securely. Spray the ground cable connections with dielectric red enamel.

54–02 Battery Voltage Checking

Check the battery open circuit voltage using an accurate voltmeter. If the voltmeter registers 12.5V or below, fully charge the battery to 12.65V. A fully charged battery will have a voltage of 12.65V with the charger disconnected.

Index, Alphabetical

Title of Maintenance Operation (MOP)	MOP Number
Air Conditioner Inspecting	83–01
Safety Precautions	

Safety Precautions

⚠ DANGER

When working on the vehicle, shut down the engine, set the parking brake, and chock the tires. Before working under the vehicle, always place jack stands under the frame rails to ensure the vehicle can not drop. Failure to follow these steps could result in serious personal injury or death.

83–01 Air Conditioner Inspecting

⚠ WARNING

Wear eye protection, gloves, and protective clothing when working on the air conditioning system. Leaking refrigerant from a damaged hose or line could cause blindness or serious skin burns.

1. Park the vehicle on a level surface, shutdown the engine, apply the parking brake, and chock the tires.

⚠ CAUTION

To avoid the possibility of burns, make certain that the engine and air conditioner components are not hot.

2. Check the appearance of the air conditioner compressor pulley assembly. If the friction surface of the pulley shows signs of excessive grooving due to belt slippage, replace both the pulley and the drive plate. Visually inspect the refrigerant compressor drive belt for damage, and check that the belt is set at the proper tension. Also check the tightness of the compressor mounting fasteners. For instructions and torque values and for removal and installation procedures, see **Group 83** of the *Recreational Vehicle Chassis Workshop Manual*, or take the vehicle to an authorized Freightliner dealer.
3. Inspect the compressor clutch coil wire. Ensure that the connector is not damaged or loose. Replace the wire if it is damaged.
4. Check the overall condition of the air conditioning hoses. Look for cracks, cuts, and abrasions on the hoses. Replace damaged hoses; see **Group 83** of the *Recreational Vehicle Chassis Workshop Manual* for replacement instructions, or take the vehicle to an authorized Freightliner dealer. Also, visually check for loose fittings on all air conditioning components. Do not overtighten the fittings.
5. Check for a buildup of road debris on the condenser fins. Using air pressure and a whisk broom or a soapy spray of water, carefully clean off the condenser. Be careful not to bend the fins.